Alternative Development Strategies of Korea (1976-1990) in an Input-Output Dynamic Simulation Model

SWP250

World Bank Staff Working Paper No. 250

March 1977

epared by: S. Gupta
sisted by: Ron Padula

mparative Analysis and Projections Division
onomic Analysis and Projections Department

WORLD BANK

Bank Staff Working Paper No. 250

ALTERNATIVE DEVELOPMENT STRATEGIES OF KOREA (1976-1990) IN AN INPUT-OUTPUT DYNAMIC SIMULATION MODEL

March 1977

This long-term planning model was developed in conjunction with the Economic Planning Board of Korea and the Korea Development Institute, and was used by the Bank Basic Economic Mission to Seoul in 1976. The model simulates the Korean economy and enables the planner to test the impact of a given policy or set of policies through the use of sensitivity analysis.

An important feature of this study is that it attempts what might be called social cost-benefit analysis at a macro-economic level. That is, it explores the social costs of growth as well as the advantages, and thus provides a framework in which to analyze various policy packages that are being considered in the Korean development community. Several general conclusions about the future of Korea's economy have been drawn:

1. An annual GDP growth rate of at least 9% will be necessary over the next decade to insure acceptable targets in employment and equity.
2. A policy of continued high export growth is both feasible and necessary for Korea's economy.
3. Income equity may deteriorate until 1985, despite high GDP growth; after 1985, income equity should improve as the population impact of the "baby boom" in Korea begins to subside.

The paper's main thrust is that Korea's justifiable quest for high growth must be tempered by sober consideration of the social costs entailed in a given policy. Some of the "costs" mentioned in this study are excessive urbanization, and increased dependence on foreign markets, and vulnerability to international price changes.

Prepared by S. Gupta
Assisted by Ron Padula

Comparative Analysis and Projections Division
Economic Analysis and Projections Department

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

This Model was developed initially in collaboration with the Economic Planning Board and the Development Institute of Korea, for the Fourth Plan. I am indebted to Dr. H. Song and Mr. Rhee of the K.D.I. for full cooperation and assistance. Subsequently this Model has been much expanded in connection with the Bank Economic Mission in Korea. I received invaluable support from all mission members. Messrs. Parvez Hasan and D. C. Rao helped me at all stages by their very valuable advice and comments. I am also thankful to Mr. Sherman Robinson, who joined me in developing a large part of the income distribution sub-routine.

For computation and model specification I am indebted to Mr. Jan Gunning for his help. Mr. Ronald Padula assisted me in all stages, from the computer to the final editing of this paper.

I am also indebted to Mr. Wouter Tims, Mr. Nicholas Carter, Mr. Graham Pyatt, Mr. Montek Ahluwalia, Dr. Kim Jee Ik of the E.P.B. and Dr. Kim Mahn Je of the K.D.I. Korea, Mr. Roger Norton and Mrs. Rita Putnam for their comments, encouragement and help at all stages.

ALTERNATIVE DEVELOPMENT STRATEGIES OF KOREA (1976-1990) IN AN INPUT-OUTPUT DYNAMIC SIMULATION MODEL

I. INTRODUCTION

1. The growth of an economy can be compared to the growth of any living organism. In its growth process, the economy may occasionally develop ailments due to external shocks (such as world market conditions, weather, or purely non-economic activities), or due to those internal actions (such as uncoordinated decisions made by the household, institutional, or government sectors) which reflect imperfect knowledge and forethought and, occasionally, conflicting interests. Ailments might appear in the forms of inflation, sub-optimal use of resources, unemployment, poverty, or balance of payments crises. The economist's role in this context is similar to that of a medical doctor: to prescribe medicine. Modeling activities resemble laboratory tests: they can be used for diagnosis, and for the testing of different medicines. Generally, all short and medium term models are of this type.

2. There also exists another class of model. Just as medical doctors can recommend salutary living habits, which promote health and longevity, so can economists attempt to set forth rules of economic behavior which provide a desirable future growth path for the economy, with a minimum of harm from external and internal disturbances. This is the role (normative in nature) of planning and policy models: they explore the social and economic implications of a particular set of policy decisions. The Korea model described here is of this class.

3. This model was developed to give a planning framework in which to evaluate the Fourth Plan and develop a long term growth strategy for the country (running through 1990). As Korea begins the period of the Fourth Five Year Plan (1977-1981), it will be faced by several clear economic realities and constraints. The international price of petroleum and the growth of the Korean population and labor force make necessary a high rate of economic growth. This will entail, inter alia, the continuation of its remarkable performance in exports. Starting virtually from scratch in the mid-sixties, Korea's exports now represent billions of dollars a year, and comprise an increasingly large share of the country's gross domestic product.

4. Several key questions arise. Can the growth of Korean exports continue in an increasingly competitive world market? Will its terms of trade deteriorate? Is there a "ceiling" in terms of the ratio of exports to gross domestic product? What rate of growth will be required to ensure adequate employment, given the increase in Korea's labor force? What course will income distribution take in the coming years? Can we measure the "quality" of growth (i.e. its ability to improve income distribution while at the same time minimizing social costs such as pollution, excessive urbanization, and dependence on foreign markets and resources)? If so, can we use the quality of growth as a criterion for determining the relative merit of alternative development strategies?

5. These questions, among others, are currently being debated among government officials and planners in Korea. In its abridged version this model has been developed in collaboration with the Koreans and has been used as the "model-base" of the Korea IV plan. It is a macroeconomic planning model which is comprehensive enough to allow the economist to execute numerous simulations which will test the effect upon the economy of a given policy or set of policies.

II. MODEL STRUCTURE

6. The model was initially developed in collaboration with the Korean Development Institute and the Economic Planning Board. Later, it was expanded to explore new policy variables and long-term development strategies, especially in areas such as demography and price formation. The choice of specifications has been constrained by three important considerations:

- The Korean Third Plan Model Specification;
- The data availability, especially regarding input/output relations, family budget surveys, and time series information;
- The purpose of this study, which was to provide a framework for policy analysis.

7. Structurally, the model is composed of various groupings, or "blocks," of equations: there is a production block, an employment block, an income distribution block, and so forth. The computer solves the equation system of the model in a recursive fashion (that is, it determines all values for a given year, and then moves on to the next year, using last year's calculated values as a base). 1973 was used as the model's base year, hence the projection span begins in 1974.

8. This chapter begins by highlighting the model's special features, and then presents the overall structure of the model, block by block, in general economic terms. More detailed analysis can be found in the appendix, under the title "Model System."

9. The Korea Model has the following special features:

(a) The supply-demand balance for each specific sector is ensured at 1973 prices.

(b) Prices are estimated in the model by cost of production considerations (i.e. long-term price trends).

(c) Consumption in the model is income-elastic and is estimated separately for each occupation, income class, and item. The consumption effect of changes in relative prices works through income shifts between different classes.

(d) Income distribution has been made a function of:

i) changes in product prices
ii) factor prices
iii) differential sectoral growth
iv) population growth, and
v) dependency ratios in different occupation groups and income classes, which, in turn, are dependent on demographic considerations and unemployment levels in each sector.

(e) The volume of investment is endogenous in the model and is a function of domestic and foreign saving. Investment allocation between sectors is mostly a policy variable; in a few sectors it is export demand oriented.

(f) Savings and consumption propensities in the model are derived from family budget surveys and are not residual, as they frequently are in National Income accounts.

(g) The exports in the model are mainly demand oriented, while imports are requirement oriented. Ex ante and ex post imports are balanced by changes in the effective exchange rates.

(h) The wage rate is a function of productivity growth (long-run) and cost of living and unemployment (short-run, Phillips curve).

10. To summarize, this is a dynamic input/output model with a closed loop (i.e. output determines demand and demand determines output). The main adjustment mechanism between demand for, and supply of, sectoral outputs is the change

in relative prices, both domestic and foreign. Though the model is essentially long-term in perspective, it does solve the equation system for all years, and should not be considered a terminal period exercise. Results are simulated on a year-to-year basis, which ensures feasibility as well as consistency. Feasibility can be checked only by tracing the path of the adjustment process.

11. The model attempts to combine national income accounts with input/output accounts and flow of funds (like Stone's Social Accounting Matrix) 1/ in a simplified framework. In the solution algorithm, it uses iterative methods to solve a set of non-linear equations (which number nearly 1600).

A. Production Block

12. Production is exogenous in three sectors in the model: food grains, agriculture (other than food grains), and mining. These sectors are largely affected by climate and by other non-economic factors, and production estimates are all made independently by agriculture experts. Incremental production in the other sectors is treated endogenously, and determined by past investments, assuming different gestation lags. The adjusted incremental capital output ratios (ICORs) are estimated from unadjusted ICORs derived by the KDI and EPB in Korea. These basic ICORs were based on time series and on project studies.

13. Investments by destination are partly endogenous and partly determined by policy. Aggregate investment is determined by total investable funds, which are the aggregate of domestic and foreign saving. These funds initially are needed for working capital, replacement investment, and the growth of agriculture and mining. The residue is allocated to different sectors by exogenous allocation parameters. These allocation parameters are borrowed from the Korea Plan in the base run. If any sector's output is to be increased, either because of increased export targets or increased domestic requirements, the allocation parameters of that sector are increased endogenously on a requirement basis. Investments by source are derived from investments by destination by means of a normalized capital flow matrix (Table 23a).

1/"A Social Accounting Matrix for 1960"(A Programme for Growth Series),1962, Cambridge University, Department of Applied Economics.

B. Employment Block

14. Employment in each sector is determined by employment elasticities in each sector, with respect to changes in sectoral value added. This assumption, in conjunction with the assumption of fixed ICORs, implicitly gives a production function with increasing substitution of labor by capital (See Gupta 1/). The employment category has been divided into wage earners and self-employed. The self-employed group includes small entrepreneurs who individually operate their own plants. The employment elasticities of the self-employed with respect to changes in sectoral value added are lower than those of the wage earners. (Thus, growth of output will not be matched by a commensurate growth in self-employment.) This suggests an increase in the size of plants over time.

15. The total population and working population have been estimated exogenously in the model, based on the age structure of the population in the base period and assuming certain fertility and mortality rates. The model separately estimates the base period dependency ratios for the rural and urban households (from household survey data). The rate of change of the dependency ratio has been assumed to be the same in rural and urban areas.

16. Out-migration from rural areas has been estimated on the basis of an econometric relationship derived from time series data. The rate of migration has been assumed to be a function of growth in the non-agriculture sector with some distributed lag. Farm population has been allowed to grow at the average national rate, but is reduced yearly by out-migration to the urban sector.

C. Income Distribution Block

17. The income of the rural sectors (agriculture and mining) is the income accruing to them net of depreciation, indirect taxes (including customs duty) and other non-tax levies. Estimates of the incidence of all these taxes have been drawn from past observation. The per capita income of

---

1/ "Income Distribution, Employment and Growth: A Case Study of Indonesia", World Bank Staff Working Paper No. 212,1975, page 41.

the rural sectors is derived by dividing the value added in these sectors by the number of wage earners and self-employed, after being multiplied by the average dependency ratios of these sectors. Dependency ratios are made functions of base period dependency ratios, the index of their change, and the number of unemployed, allocated between sectors. The logic behind this procedure is that at any point in time an unemployed person must be dependent upon some household, reducing the average income of that household as derived from the base period dependency ratios. In this model the unemployed have largely been allocated to the rural sectors and to the urban informal sector, on the basis of information and experience from other developing countries.

18. The distribution of the average income of an occupational class of a given sector is estimated using the variance derived from the base period data. 1/ In the base period, a lognormal distribution has been fitted for each sector and occupation class. Fits are in most cases satisfactory.

19. The average income of the urban wage earners has been derived by calculating the changes in the average money wage level for each class from the base period level. The wage rates in any period are dependent on cost of living changes, the level of unemployment, and the changes in labor productivity in each sector.

20. The responsiveness of wages to changes in productivity, cost of living, and unemployment have been estimated on the following assumptions: wages adjust to changes in the cost of living with a year lag when unemployment is 5% (i.e. the base figure) and the time lag increases or decreases depending on the unemployment rate rising or falling from the base figure. The elasticity of wage changes for a given productivity change has been estimated as a policy variable and is based upon past observation, as well as consultation with the EPB of Korea. Real wage changes for the rural sectors and urban sectors are derived by deflation, using corresponding cost of living changes. The average level of income for urban wage earners is derived in the same way as for the rural sector.

1/ See Irma Adelman and Sherman Robinson, Income Distribution Policy in the Developing Countries: A Case Study of Korea, forthcoming: Stanford University Press and Oxford University Press.

21. The income of the self-employed in the urban sectors is determined by subtracting from the total net value added in each sector of urban origin the payments made to the wage earners. By rough approximation it is assumed that the rural sector is exclusively identified with agriculture and mining, and that all the remaining sectors belong to the urban group.

22. After full employment is reached, the "use" of labor is economized among the self-employed in the services, trade, and agriculture sectors. This is based on the rationale that the base period employment parameters in these sectors contained disguised idle manpower.

D. Consumption and Savings Block

23. Domestic savings in the model have been divided into four parts:

- Household savings;
- Corporate savings;
- Government savings;
- Additional savings, either in the household or the government sectors.

Household saving is the sum of savings generated by households in different income classes and in different occupations. The savings propensity in any sector is a function of real disposable income on a per capita basis. Thus, total household savings have been made a function of the sectoral composition of incomes, the incidence distribution of all taxes, the age structure of the population, and the dependency ratios in different occupations and income classes. Government saving is defined as the difference between government revenue and government consumption. Corporate saving has been made a function of corporate growth in general, and of export growth in particular. Equations pertaining to private savings, total savings, and foreign savings are all definitional identities.

Public Finance

24. Receipts from direct and indirect taxes have been estimated on an average basis. For direct taxes separate rates have been estimated for different income levels and for different occupations. For indirect taxes, separate rates apply to different commodities. Customs duties are also levied at different rates on different imported items. Non-tax revenues and tax receipts for local taxes, inheritance tax, monopoly gains and so forth, are exogenous in the model. The growth of government consumption has been made a policy variable and the composition of its consumption basket is exogenous.

Price

25. Price is endogenous in the model. The sectoral price equation is estimated on a "cost mark-up" principle and is based on 1970 intermediate input coefficients and on changes in capital/labor relations and import/gross output relations, as well as changes in factor and external prices. It has the following components:

- Wage cost
- Capital cost
- Cost of imported intermediate goods
- Indirect tax rate
- Cost changes due to changes in productivity (technology)
- Changes in the cost of imported intermediate goods due to changes in exchange rates and tariffs.

26. These six components are the basis for sectoral gross output prices. The GDP deflator (the net value price) is equivalent to the average of gross output prices weighted by the final demand elements of any period. Changes in technology affect prices through changes in real wages, rates of return on capital, and the weights by which the primary inputs are combined (i.e. labor/capital ratios). These technology changes in the model operate through changes

in ICORs and changes in employment elasticities. The effect of import substitution operates through import/output ratios (acting as weights) and changes in exchange rates.

27. The cost of living index of any relevant income group is the weighted price of the relevant consumption basket of that group. Export and import prices in dollars are exogenous, and domestic c.i.f. prices are adjusted by the exchange rate changes.

Export/Import Sectors

28. Exports are exogenous in the model. This is to say, it is assumed implicitly that export is "demand determined" and is based on demand in the external markets. Imports in the model have been estimated as follows:

- Imports are estimated on the basis of a residual flow approach, i.e. any shortage of demand, domestic or foreign, is met by imports.
- Import demand is based on the base year average import propensities of the intermediate and capital goods sectors (propensities determined by the technology in use), and of the consumption sector (which will be largely behavioral).
- Ex ante import demands in each year are estimated on the basis of the ratio of last year's imports to total demand.

29. There is a rationale for having three different approaches to import determination. Ex post imports are determined by the residual flow method, which gives a consistent equilibrium position. The last period's import coefficients refer to ex post (realized) parameters for the present year. Hence, a deviation from last year's parameters will represent the import substitution achieved for this year. The model has a "floor" (minimum non-competitive level) for imports based on technology factors. Any level of imports below this is impossible. On behavioral grounds, there must be some price mechanism operating to make this import substitution feasible. Changes in the effective exchange rate operate as the equilibrium mechanism. Base period parameters are also used to get an overall idea of the total import substitution achieved over the whole projection period. Non-competitive imports have been calculated on the basis of a non-competitive import matrix, derived from the 1970 input-output table.

E. Capital Accounts Block

30. The current account balance of the model has been estimated from the capital account side: it is the sum of net official and unofficial capital inflows and changes in reserves. It is affected largely by commitment, disbursement, and amortization patterns of foreign loans, in addition to other capital transactions.

31. The resource balance is equivalent to the current account balance, adjusted for net factor services payment and net transfers. It is matched by imports, net of exports, in current dollars. The resource balance in constant local currency is estimated by deflating the current resource balance by import price deflators (c.i.f.) and adjusted further by terms of trade changes between the base year and the current year.

$$Mpm - Epe = A$$

$$M - E\frac{pe}{pm} = A/pm$$

$$M - E - E\left(\frac{pe}{pm} - 1\right) = A/pm$$

$$M - E = A/pm + E\left(\frac{pe}{pm} - 1\right)$$

M = Imports at constant price

E = Exports at constant price

pe = Export price index

pm = Import price index

A = Current price resource balance

F. The Flow Chart

32. Table II.1 gives a simplified version of the flow relationships among the different economic activities in the model. The capital stock (KT) and the supply of labor (LABFOR) determine the production level (GROSS OUTPUT) under a given set of technological conditions (input-output matrix and production function) in any period. Because the model is based on fixed capital/output relationships, the level of production activities at a given period may or may not absorb the whole labor force (LABFOR). The result - unemployment (LABUNM) - is given in the chart. The value of gross output net of intermediate payments is distributed between factors through the factor market (FACMAKT), and enters as income in the household, corporate, and government sectors.

33. These sectors spend part of this income (CONS) and save the rest (HS, CS, GS). The sum of these savings represents total domestic savings. Foreign saving equals the net import surplus of the country. Cumulatively, these savings finance the total investment of the country (INV). The total supply of goods and services of the country (DOMSUPPLY) constitute domestic output (gross) and imports (MT). The total demand matching this supply (at prevailing market prices) consists of consumption (CONS), investment (INV), and exports (EXP). The import surplus represents the difference between imports and exports. The capital stock of the next period (KT_1) is the sum of the current period's capital stock plus the net investment of this period. The total labor force (LABFOR) is estimated from population growth, age structure, and participation rates.

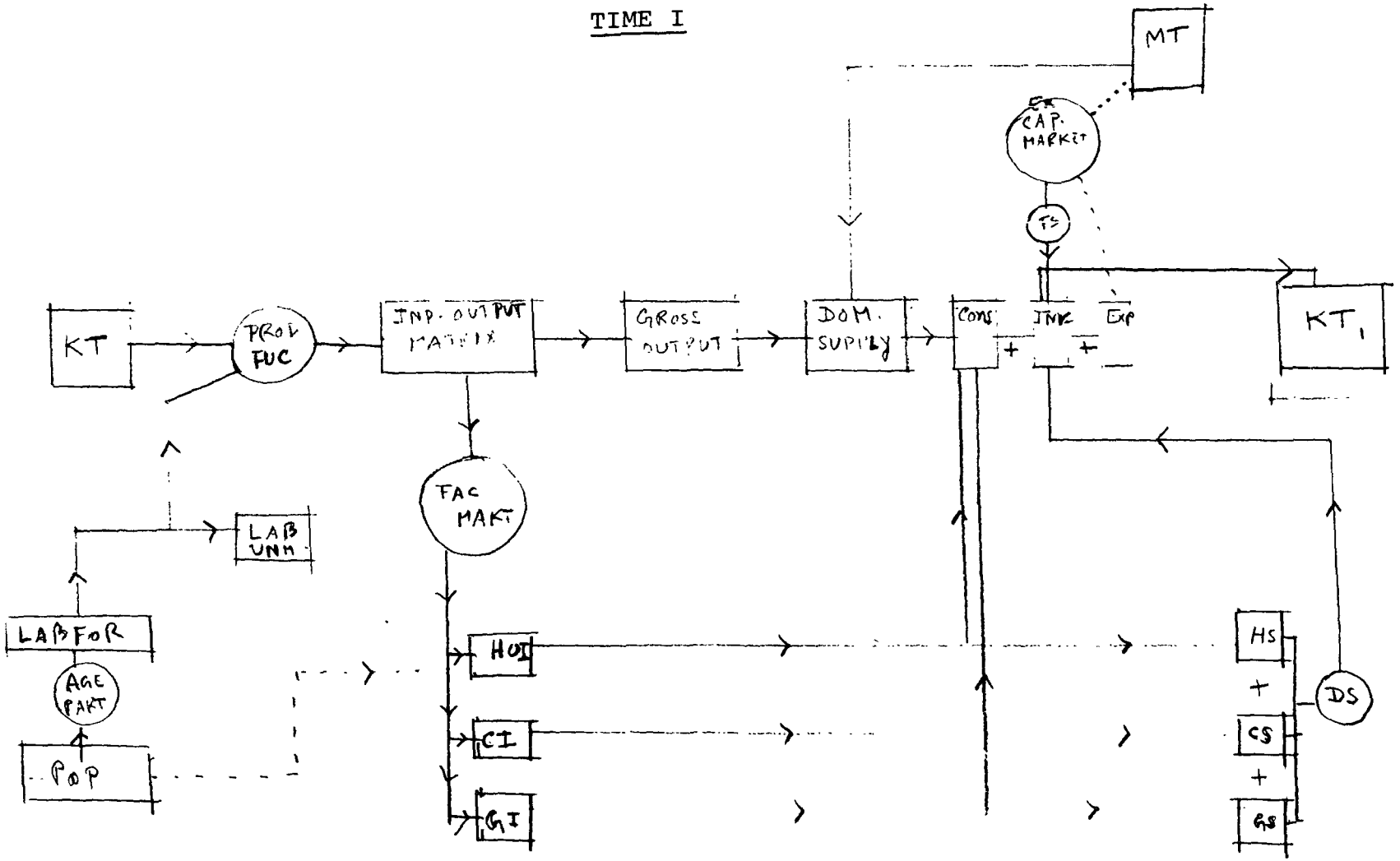
III. A NOTE ON THE DATA BASE

34. The sector classification scheme of the model is more detailed than that used for the Fourth Korea Plan: the Plan contains eleven sectors, while this model contains seventeen. These sectors are aggregated from a 53-sector inter-industry table for 1970, which presents both a domestic and an import coefficient matrix. In addition, we have used a capital flow coefficient matrix computed by the Korea Development Institute; this matrix was derived from a 1968 wealth survey and subsequently was revised on the basis of a 1974 survey.

TABLE II.1

Simplified Flow Chart of the Model Relations
(Notation see next page)

TIME I



TIME-2

KT	=	Capital Stock
PRODFUC	=	Production function
INP-OUT MATRIX	=	Input-Output matrix
DOM SUPPLY	=	Domestic Supply
CONS	=	Consumption, private and public
INV	=	Investment (Gross)
EXP	=	Exports
MT	=	Imports
FS	=	Foreign Saving
EX CAP MARKET	=	External Capital Market
HS	=	Household Saving
CS	=	Corporate Saving
GS	=	Government Saving
FAC MAKT	=	Factor Market
HOI	=	Household Income
CI	=	Corporate Income
GI	=	Government Income
POP	=	Population
AGE PART	=	Age structure and participation rates
LAB FOR	=	Labor force
LAB UNM	=	Unemployment

35. The incremental capital output ratios are derived mainly from two sources: the static input-output terminal period model built by Roger Norton and Kim Myun Hyung and the Fourth Korea Plan simulation model perfected by S. Gupta and S. Song in collaboration with the Economic Planning Board of Korea. Both of these sets of coefficients are based on the 1968 wealth survey referred to above, and on sectoral and project information on investment and generation of new capacity. However, the second set of coefficients is seen to be unrealistically low when compared with the past, so we confined ourselves to the first set of coefficients. For example, between 1964 and 1975 the capital/output ratios with a one year lag ranged from 1.2 to 4.511, at 1975 prices. This represents an average of 2.8 over the whole period. In the Plan an unlagged capital/output ratio of 2.9 has been adopted. In our assessment, though, even the range 2.8-2.9 seems low. There are two reasons for this. First, it assumes that the ratio of replacement investment to total investment will remain unchanged in future from the ratio observed during 1964-1975. This assumption underestimates the requirement for replacement investments in the future, (when more than 80% of capital will be new, or installed during the last decade). Second, the proportion of inventory holdings is likely to increase for a country whose foreign trade sector will double as a share of the whole economy over fifteen years. Further, detailed scrutiny shows that a large number of ICORs are based on very optimistic expectations about improving capital efficiency in many sectors over the next plan period.

36. Before we could use these capital/output ratios in the model, however, an adjustment was needed for incorporating the gestation lags between the investments and the outputs. Different gestation lags have been assumed for different sectors (see Table 13a) and have been estimated from project information in Korea and from international comparison. If ICOR (-1) represents ICOR with one year gestation and ICOR (-n) represents ICOR with 'n' period gestation, then:

$$\text{ICOR}\ (n) = \text{ICOR}\ (-1)/(1+r)^{n-1}$$

where 'r' is the rate of growth of investment in that sector over the period. Over the projected period, an average of 9.5% per annum growth of investment has been assumed in the model. The ex post aggregate ICORs (with one year lag) have been estimated in this model (based on the sectoral ICORs) in order to compare them with the historical benchmark ICORs based on past national income tables.

37. The employment elasticities have been estimated in collaboration with the Economic Planning Board and, in broad aggregates, they are almost the same as those of the Plan. They are also fairly close, in comparison, to past time series data. An exact comparison is difficult, though, because the model values are more disaggregated, and because annual time series observations are affected by short-term economic fluctuations. The aggregate employment elasticities for the economy range from .211 to .867 over the sample period (1964-1975). Aggregating over the whole period the estimated elasticity is .386, very close to the 1981-1990 (.324). In the Plan, the average employment elasticity is .369.

38. The working capital matrix (table 24a) has been estimated from the 1973 table and has been regarded as diagonal. This is a fairly strong assumption, but a necessary one in the absence of more detailed information.

39. Four different savings propensities are estimated for four separate classes and for each occupation (Table 14a). The ratio of self-employed to wage earners (Table 16a) has been estimated from Adelman's model on Korea. 1/ Numbers of wage earners and self-employed are estimated from these ratios and from the distribution of sectoral labor force for the year 1973, as given by the KDI.

40. Total population and working population have been estimated by the Bank mission team. The lag variance of income for each occupation class is derived from Adelman's study on Korea. The composition of the government sector's consumption is based on the percentage of government consumption in the 1973 input-output table. Direct tax rates

1/ Adelman and Robinson, forthcoming, op.cit.

for households are borrowed from the 1974 family budget survey and changed exogenously over the projected period from Plan information. The same is applicable for customs duties. Other revenue items are assumed to be the same as in the Plan until 1981, and are exogenous thereafter. The investment allocation for each sector, especially manufacturing, is derived from Plan information and from the detailed work done by the mission members.

41. Exports were estimated exogenously in the model by the mission experts. Separate simulations have been done with alternative growth rates. Price projections in the world market for Korean tradable goods assume a 5% inflation rate.

42. The model estimates the number of people below the minimum standard of living, defined as the income level below which minimum nutritional needs cannot be met. Minimum nutritional needs have been derived from a 1974 household survey conducted by the Bank's Korea division. By using the 1974 retail price series for commodities, estimated by Messrs. S. H. Kim and D. Kim, the cutoff point below which minimum nutritional needs cannot be met is calculated to be 61,000 won for the urban sector, and 55,824 won for the rural sector. In the base year, 1974, the total number of people below the minimum nutrition line was 3.77 million; in 1976, our model estimates the number to be 3.02 million.

IV. FINDINGS

43. Every development strategy entails social benefits and costs: hence, one or more implicit trade-offs will exist. Choosing these trade-offs in a given policy package is the essence of planning, and the good planner considers the widest possible range of policy options that fall within the realm of the feasible. The "choice range" in the immediate future (in some sectors even for two to three years) is much restricted by past actions. For example, the growth pattern of the early years of the Fourth Plan is largely ordained by investments already made in the Third Plan. This fact has narrowed down the range of

alternatives further in the immediate future. At the same time, it emphasizes the importance of knowing the long-term implications of an economic decision taken today.

A. Alternative Growth Paths

44. Of the many alternatives considered, ten are reported in this paper to bring out the broad development choices facing the country. The ten alternatives differ on the basis of four different assumptions regarding exogenous variables and two different assumptions about policy variables. The four exogenous variables are a) exports; b) aid commitments and net private capital inflow; c) world price movements and d) population growth. The two policy variables are tax policy and wage policy.

Alternative	Export Growth	Savings Rate	Terms of Trade	Population Growth	Wage Rates	Tax Progressivity
1	M	M	POS	L	.8	P + T
2	M	L	POS	L	.8	P + T
3	H	M	POS	L	.8	P + T
4	H	L	POS	L	.8	P + T
5	L	M	POS	L	.8	P + T
6	M	M	POS	H	.8	P + T
7	M	M	POS	L	1.2	P + T
8	M	L	O	L	.8	P + T
9	M	M	POS	L	.8	PRT
10	M	LL	POS	L	.8	P + T

45. To be more precise, three alternative levels of export growth have been assumed between 1981 and 1990. Between 1976 and 1981, the Plan growth rate of exports has been assumed in all the alternative runs. The three average alternative growth rates of exports between 1976 and 1990 are: a) 19.3%(H); b) 16.6%(M) and c) 14.6%(L).

46. As for foreign savings, three alternative levels are assumed: a) a very low foreign savings of .001% of GNP in 1981 and -.009% in 1990 (LL); b) a low foreign savings of 1.3% of GNP in 1981 and -.01 in 1990 (L) and c) a medium foreign savings of 3.9% in 1981 and zero in 1990 (M).

47. The terms of trade are assumed either to remain at their 1975 level (0), or to remain at the level which existed in 1976 (after a rise from the 1975 level). There are two population growth rates: a) that assumed in the mission estimates (see table 22A), and b) 2% p.a. after 1981.

48. Wage rates are assumed to be dependent upon: changes in productivity, changes in cost of living, and unemployment rates. Two major alternative wage policies have been assumed: a) wage rates will change as 80% of the changes in labor productivity; b) wage rates will change as 120% of the changes in labor productivity.

49. Last, experiments have been made with two alternative tax structures, changing only the direct tax rates; a) Inheritance, capital gains and local taxes have been assumed as in the Fourth Plan, with steady growth after 1981 (P); b) Income and corporate taxes, indirect (sales) taxes, net of subsidies, and tariff rates are assumed to remain the same in each sector, though their levels are adjusted to match the actual levels in 1976 (T). Direct tax rates in one alternative have been made highly progressive, by imposing them only on the rich, at a rate which will keep the total direct tax revenue of the government almost unchanged (PRT), as in the other alternative. In the other alternative, they have been distributed among all income classes as they were in 1974.

50. Table 1 gives growth differences over time. It is evident that the main divergence does not start until after 1981. The highest growth rate is achieved by alternatives (3) and (7) and the lowest by (8). To move from a low growth rate to a high one, there must be an increase in wages, capital inflow, or exports. Let us now examine the costs and benefits of this move from a low growth path to a high one.

51. From the benefits side, high growth improves the employment situation. It reduces income inequality both in terms of the Gini coefficient and in terms of the percentage of income going to the lowest 40% of the population (see Table 20), and it reduces the number of people who cannot maintain a minimum nutritional level. Table 3 depicts the contrast between the high and low growth strategies. In the higher growth case the fall in the number of people below the minimum living standard is instantaneous, but inequality continues to worsen until 1986.

52. The social cost, however, is quite heavy. Higher growth will increase a) the degree of urbanization (urban population as a proportion of total population), b) the country's dependence on imported food and energy, and c) domestic prices. Moreover, it will increase the dependence of manufacturing on export demand from 44% in the low growth case to 70% in the high growth case. (See Table 4). Last, the debt service ratio (debt service/exports) will go up considerably, from 1.7% to 8.0%.

53. These are only a few illustrative costs and benefits of the two extreme alternative growth strategies expressed graphically in Table 3 and 4. The effects of higher urbanization, the larger dependence on food imports and greater pressure on the labor market might result in a decline in export competitiveness, and in higher instability as a result of dependence on the uncertain world market, a need for higher inventory holdings, and a higher debt service commitment, as well as the obvious social problems of health and housing. Also, the question of the feasibility of the high export target will become very important.

54. To summarize, within this narrow margin of alternative scenarios, the "benefit-cost" trade-off becomes conspicuous. Assuming that both the scenarios are feasible, a compromise is reached in Run No. 1. Accordingly, this run has been chosen as a base run.

B. The Base Run

55. We divide the future long-range development of Korea into three five-year intervals: The Fourth Plan (1976-1981), the Fifth Plan (1981-1986), and the Sixth Plan (1986-1991). The long-range development of this period started with two distinct shocks: the baby boom following the Korean War and the oil crisis, with a very adverse effect on the terms of trade between 1973-74.

56. The base run (alternative 1) is given in Output Table 11 and its salient features are presented in Output Table 5. The latter shows that given a GNP growth rate of 9.4% per annum (1976-1990), the savings constraint (aggravated by the oil crisis and its adverse terms of trade effect) will vanish during the latter part of the Fifth Plan, but the impact of the baby boom, which aggravates unemployment, will continue until 1988-1989. This is mainly explained by the disparate growth rates of population and working population. Indeed, only when working population growth comes down from 3.0% to 2.4% per annum, does an amelioration in the problem of unemployment occur. The mid-term period of the Fourth Plan would indeed be the worst, in terms of unemployment and, more so, in terms of the number of people below the minimum nutrition line and the relative income distribution in the community (See Table 11 and Table 5).

57. The structural changes between 1976 and 1990 are considerable, as is shown in Table 2, but not atypical of the past. Value added in the primary sectors fell, and that of the manufacturing sector rose, as a percentage of GNP, while the service sector more or less maintained its share. The demand elasticities of agriculture, including mining, are as high as .75, whereas the elasticity of sectoral output with respect to changes in GNP is hardly .347. This demonstrates the dependence of agricultural growth upon imports.

58. Gross output proportions are given in the same table under (b). This table and Table 16 show that value added components are lowest in manufacturing and highest in agriculture, and the value added component of manufacturing as a whole has not increased over time. Hence, any claim that manufacturing is undergoing a technological improvement in terms of "a fabrication effort" has not been supported by our findings.

59. Table 2 (c) and (d) show the changes in the composition of exports and imports. In the aggregate, the export of services increases marginally as a share of total exports, manufacturing exports remain the same, and agricultural exports clearly decline. The pattern does not significantly change with regard to imports. Thus, to summarize, neither the structure of net outputs, nor the level of gross outputs, nor the composition of exports and imports undergo dramatic changes.

60. Table 14 gives sectoral exports and imports as a percentage of gross output and demand between 1977, 1981 and 1990, with separate estimates for food grains. Two salient features emerge from this table:

- As a percentage of gross output and demand, imports of food grains nearly triple between 1976 and 1990, and manufacturing increases by 150%.
- As a percentage of manufacturing output, manufacturing exports increase by 50% between 1976 and 1990. This very high proportion shows the extent of manufacturing dependence on world markets.

To sum up, Table 14 brings out the implications of structural changes more vividly than the table giving the output and export/import compositions (Table 2).

61. At this stage, an attempt is made to examine the role of import substitution in Korea. In a country where exports are increasing so fast, the conventional problem of reducing the import to demand ratio is not a relevant issue. Indeed, the proportion of demand met by imports increases from 21% in 1977 to 39% in 1990. However, the appropriate policies differ between sectors. In certain sectors where the distribution of factor endowments is skewed, domestic producers of intermediate goods would be unable to compete with imports. Foreign exchange to finance these necessary imports must be generated by exports of other sectors, which must themselves undertake import substitution if the foreign exchange savings are to grow fast enough. On this basis, in Table 15 we

normalized import increases and tried to identify positive and negative import substitution in different sectors. We noticed (as expected) that import substitution is highest in heavy manufacturing (nearly 36%) and negative in agriculture, including mining (nearly 10%).

C. Growth and Equity

62. Two different aspects of equity have been explored: the number of people below the minimum nutritional level, and relative income distribution. Relative income distribution has been measured either by the Gini coefficient or as the percentage of income going to different deciles of the population.

63. Table 6 gives the sectoral composition, in the base run, of the share of the population below the minimum standard of living (for years 1976, 1981, and 1990). The total number fell from 3.02 million in 1976 to 2.61 million in 1990. The percentage composition in the rural sector (agriculture and mining) fell from nearly 40% to zero over this period. By 1990, poverty will be confined exclusively to the urban sector, but this finding should be interpreted carefully. The non-agricultural population is identified here as urban, although some of it will remain in the villages. In the urban sector, poverty is distributed among both the wage-earners and the self-employed. The percentage composition of the self-employed poor increases over time, although in absolute terms more poverty is found among the wage-earners. Going into more detail, the population below the minimum standard of living is mostly concentrated among the wage-earners in textile fabrics, leather, and other manufacturing, and among self-employed in the transport, construction, and services sectors.

64. Table 7 gives the percentage of income among the bottom 40% of the population in the years 1976, 1981, 1986, and 1990. The percentage falls until 1986, after which it rises. 1986 is also the year when unemployment will start falling sharply and will vanish entirely by 1988-89. Unemployed people mostly appear in the model as underemployed

in the unskilled "low technology," "low productivity" jobs. When the labor market tightens, these jobs become unprofitable and slowly disappear. This is the stage where poverty declines rapidly.

65. The share of income possessed by the middle income class has remained fairly constant. This indicates that it is the income shift from the very poor to the very rich which, initially, worsens relative income distribution.

66. Relative income distribution in the rural and urban sectors and the aggregate economy has been presented in three histograms, given in Tables 8, 9, and 10. Along the x-axis the deciles of population are presented, and along the y-axis the mean income. The shaded areas show the percentage change in mean income in a given decile between 1976 and 1990 (the upper line stepwise shows the 1990 mean income, and the lower one the 1976 mean income). It is evident that income distribution, both in rural and urban areas, is becoming increasingly unequal between 1976 and 1990. The percentage increase of average income in the higher decile is higher than in the lower decile. Also the increase in inequality is greater in urban areas than in rural areas. Furthermore, the difference between the aggregate mean income in rural and urban areas is 3 to 4 times greater in 1990 than in 1976. Thus, the increase in income inequality between 1976 and 1990 is due both to intra-sectoral differences and to disparities between the rural and urban sectors.

67. This same result is corroborated by the following Gini table:

	1976	1981	1986	1990
Rural	.2424	.2498	.2620	.2773
Urban	.4155	.4317	.4528	.4253
Total	.3873	.4144	.4451	.4314

It is evident that, after 1986, income inequality starts to diminish. This is mainly due to the fact that disguised unemployment declines after 1986 mainly in the urban sector where it was largely concentrated.

The Relationship Between Growth and Equity (expressed as a concentration coefficient or as the income share of the bottom 40 percent)

68. Table 18 gives annual average growth rates between 1976 and 1990 along the x-axis, and the Gini coefficient along the y-axis. Brackets in the coordinates give the alternative run numbers. The negative slope shows that wherever growth increases, inequality invariably goes down. This means that rates of growth and equity are positively related. The rank correlation coefficient between growth and income inequality is -.840.

69. In Table 19, similar growth rates are expressed along the x-axis, and the percentage of income of the bottom 40% along the y-axis. Again, the rank correlation coefficient is as high as +.817. But when equity is related to the stage of development, expressed in terms of per capita income, we observe an inverse relationship (i.e. a trade-off) between per capita income and income equity, until a critical level of per capita income is reached. Beyond this point, income equity increases with every increase in per capita income (Table 3). This corroborates the Kuznets hypothesis. 1/ This per capita income turning point in Korea is $1000 at 1975 prices, or nearly $600 at 1973 prices.

D. A Few Sensitivities

70. An attempt was made to examine the sensitivity of GNP growth to changes in the exogenous and policy variables in the model. A 100% increase in exports seems to generate a 34% increase in growth, when such growth is measured as incremental GNP and increment in value added in the export sector. Conceptually, exports can add to growth in output a) by increasing demand, when supply is perfectly elastic; b) through terms of trade gains, when they add to investible resources; c) by allowing scarce resources such as capital to be conserved, when growth is constrained by a shortage of saving, and the export sector is less capital-intensive

---

1/ S. Kuznets, "Economic Growth and Income Inequality", American Economic Review (45) March 1955.

or, d) similarly, by allowing imports to be reduced when growth is constrained by foreign exchange and exports are less import-intensive; e) finally, by using labor more efficiently, in a labor-scarce economy where exports are less labor-intensive than other products.

71. In the present model, Korea is assumed to be a savings-constrained economy, with full employment of the initial capital stock. Hence, exports in this case have contributed to growth through (b) favorable terms of trade and (c) export production being relatively less capital-intensive than the import substituting sectors.

72. However, by calculating the sensitivity of GNP growth to export changes without a gestation lag, the export multiplier has been underestimated. Basically, such an exercise approaches the problem in a static sense, since it ignores the dynamics of comparative advantage in international trade. Hence, the result should be read with proper caution.

73. In another attempt, the rate of wage and tax policy vis-a-vis growth and equity is explored. The effect of a higher wage rate policy than that of the base run is summarized as follows:

Alternative	1976	1981	1986	1990
Base (1)				
GNP (billion won)	10349	15987	24669	36417
GINI	.387	.414	.445	.431
No.below minimum nutritional level (millions)	3.02	2.79	4.94	2.61
Higher Wage (7)				
GNP(billion won)	10349	16067	24830	37232
GINI	.388	.418	.453	.421
No.below minimum nutritional level (millions)	3.02	2.70	4.90	2.0

It is evident that higher wages not only reduce poverty and income inequality in the long run, but also improve growth (though only marginally). The constraint in using the wage policy, however, comes from resulting price increases, which endanger export competitiveness. In the base case, the price (GNP) deflator is 224 and in the high wage case it is 240 (1975 = 100). Presumably, wage earners have a higher savings propensity than the self-employed; hence, a higher wage policy means a higher savings mobilization in the economy at large and higher growth. At the same time, a higher wage level lifts wage earners from below the minimum nutrition line in low-wage sectors like textiles and other manufacturing.

74. In regard to tax policy, we tried to examine the effect of a progressive tax rate on growth and equity. Hence:

Alternative	1976	1981	1986	1990
Progressive Tax Case (9)				
GNP (billion won)	10349	15839	24303	35804
GINI	.387	.414	.446	.424
Bottom 40%	18.1	16.33	13.79	14.99
No.below minimum nutritional level (millions)	3.02	2.9	4.90	2.50

E. Conclusion

75. Given the legacy of a baby boom, and given the high price of petroleum, Korea needs to grow fast and needs to mobilize more saving, both domestic and foreign. Most domestic saving, however, should come from the corporate sector (whose share of GNP is increasing very fast-see Tables 12 and 17), and from the government sector: higher foreign borrowing is not a severe constraint if exports can grow at 14 percent a year or above. Korea will have to prepare itself, however, for the social costs of higher growth: urbanization; import dependence on

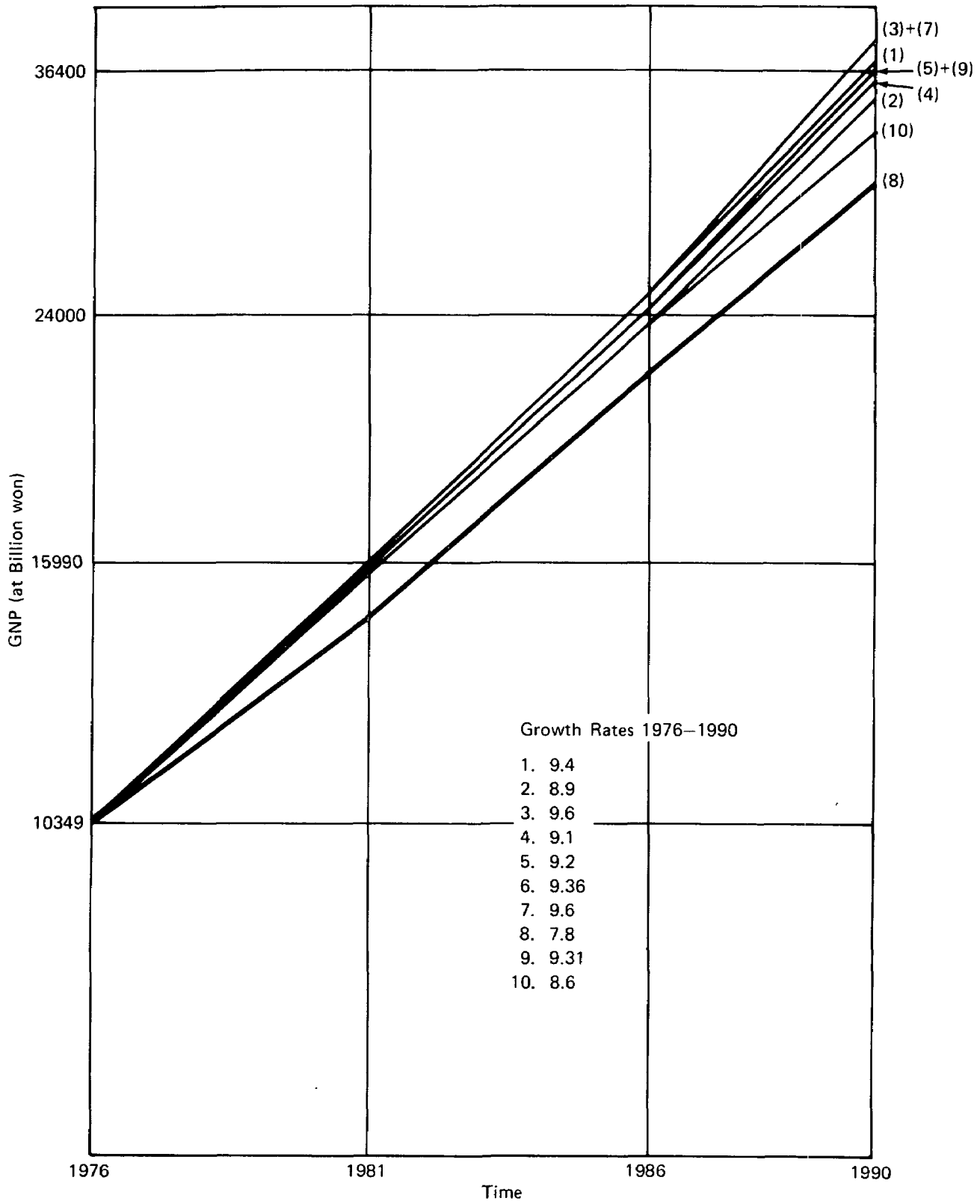
basic commodities; vulnerability to world market uncertainty; and the pressure on labor and labor costs by the end of this decade. One may be tempted to tone down a high growth policy by the use of income redistribution measures, and by not basing growth solely upon a very high rate of export growth (which in the long run may not be feasible). A GNP growth rate of approximately 9.0%, and an export growth rate of 14-15%, in the long run, seem to be a rational combination.

76. It is evident in comparing the alternative scenarios that through a redistributive tax measure, relative and absolute income distribution can be improved, but with some sacrifice of growth. This is the point where growth and equity conflict. To summarize our findings regarding growth and equity: (a) equity declines as per capita income increases, until a minimum per capita income is reached. Beyond this point, equity and per capita income are positively related. (b) higher rates of growth lead to greater equity, assuming a neutral tax policy. (c) better distribution leads to lower growth in a positive redistribution fiscal policy. 1/

1/ All these findings conform to those of our previous study on Indonesia. See "Income Distribution, Employment and Growth, A Case Study of Indonesia," op.cit.

OUTPUT TABLES

TABLE 1

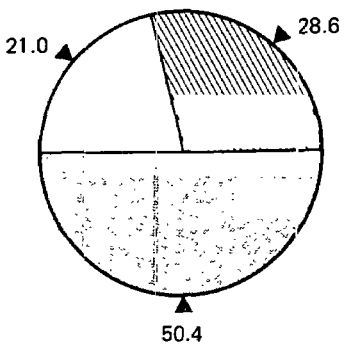


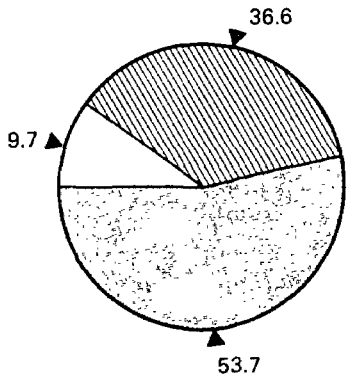
World Bank–17259

TABLE 2

Percent composition of: Agriculture, Manufacturing and Services: clockwise to:

a) GNP

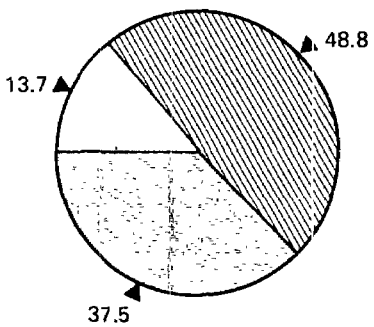


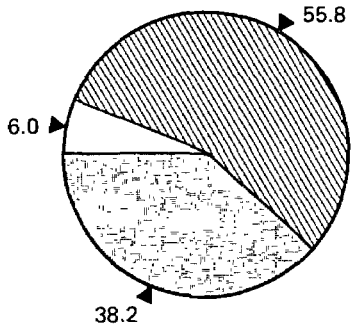


Growth per. 1977–1990

Agri.	3.3
Manf.	11.1
Ser.	10.2
T.	9.5

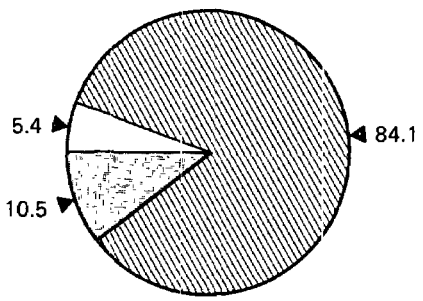
b) GROSS OUTPUT

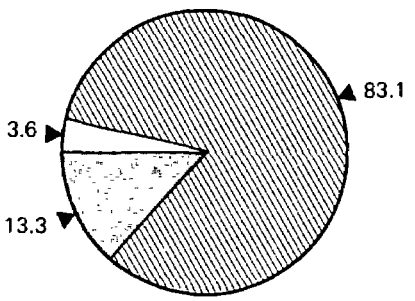




Agri.	3.3
Manf.	11.1
Ser.	10.2
T.	10.0

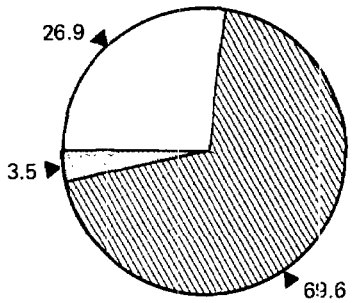
c) EXPORTS

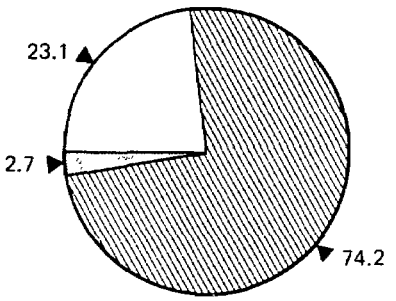




Agri.	12.4
Manf.	15.9
Ser.	18.2
T.	16.1

d) IMPORTS

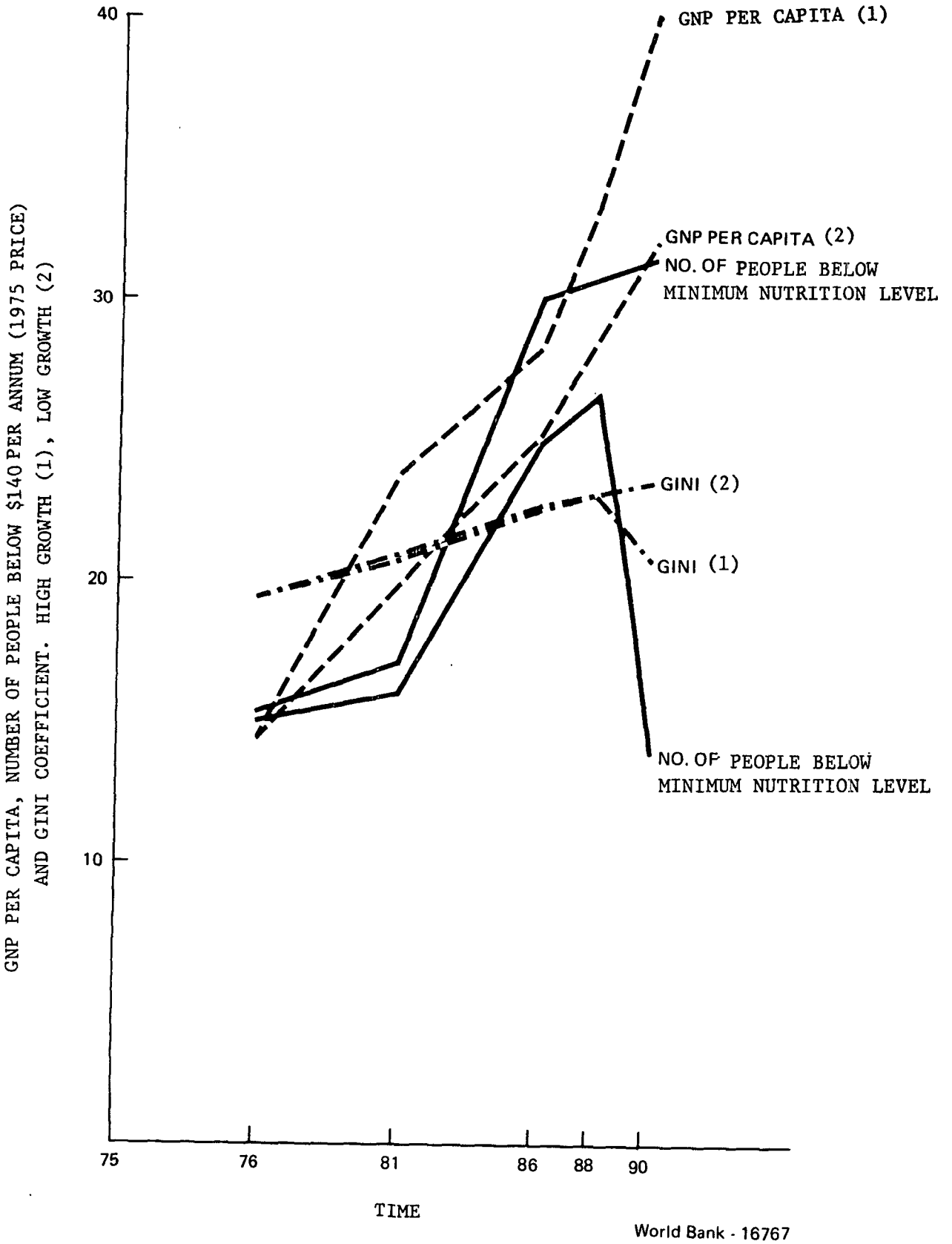




Agri.	13.8
Manf.	15.6
Ser.	12.9
T.	15 1

World Bank–17262

Table 3
GROWTH PROSPECTS AND BENEFITS OF GROWTH



World Bank - 16767

Table 4
GROWTH PROSPECTS AND COST OF GROWTH

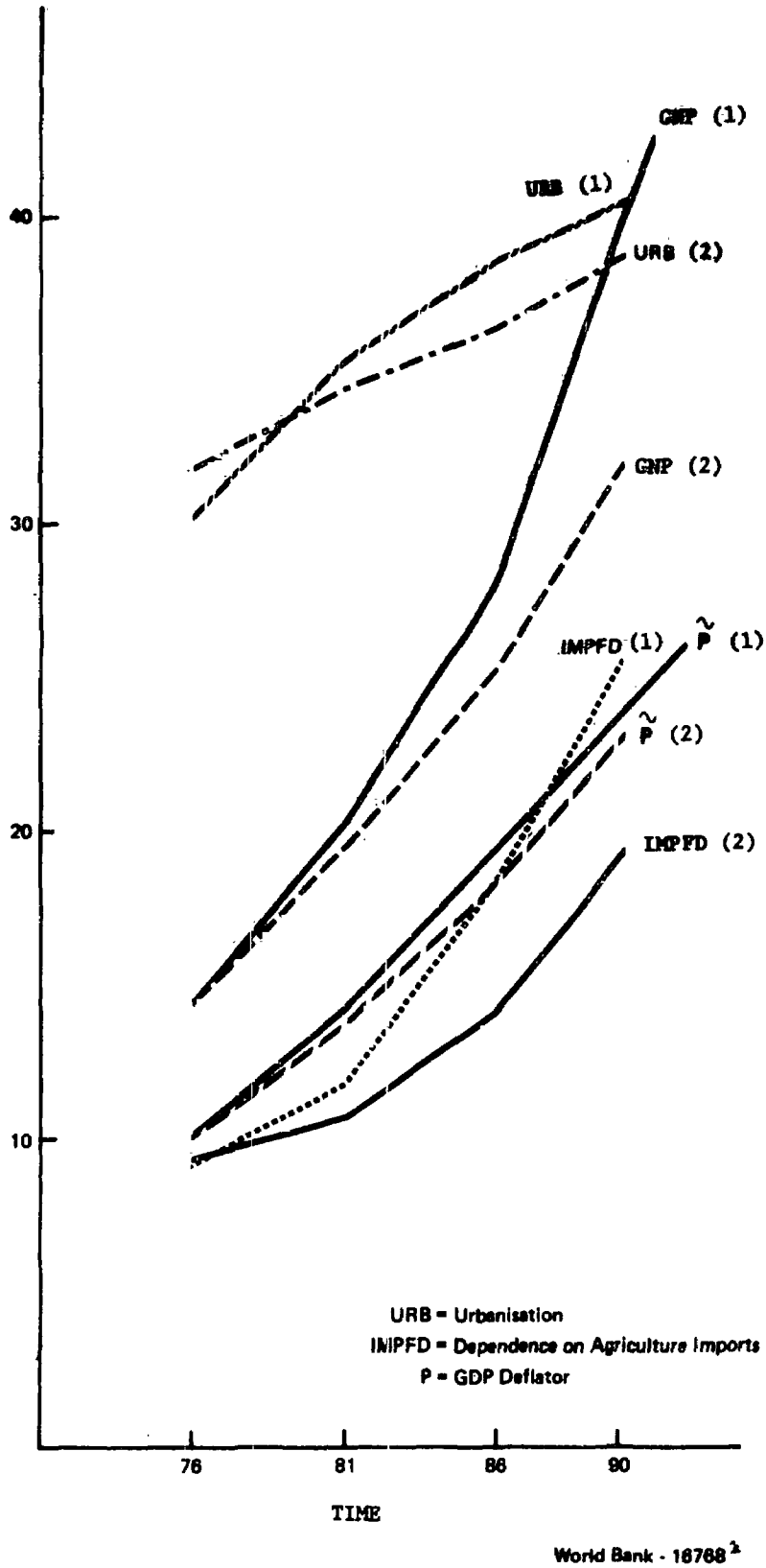
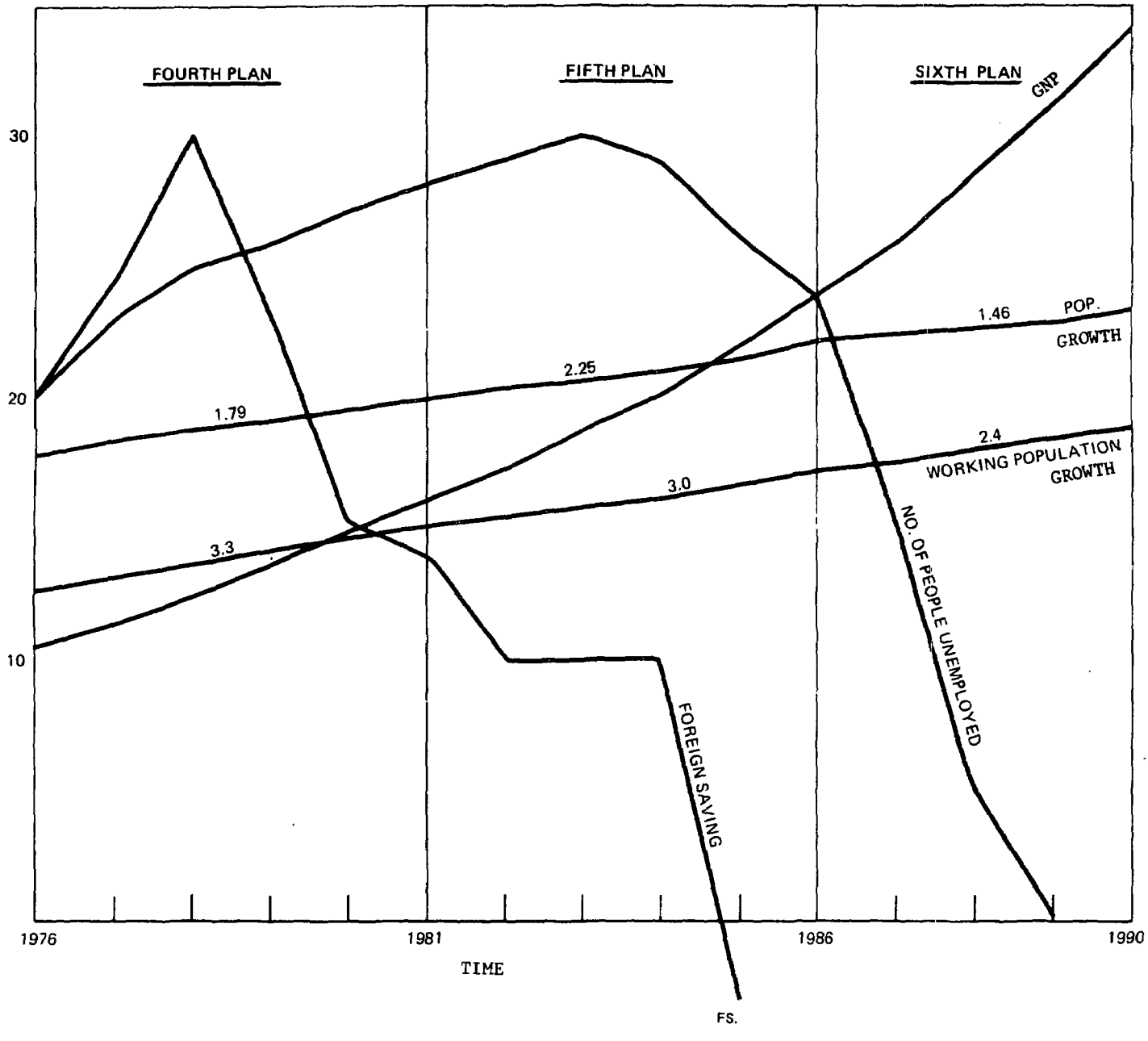


Table 5

BASE RUN: LONG TERM GROWTH PERSPECTIVE (1976-1990):
IMPACT OF BABY BOOM AND OIL CRISIS

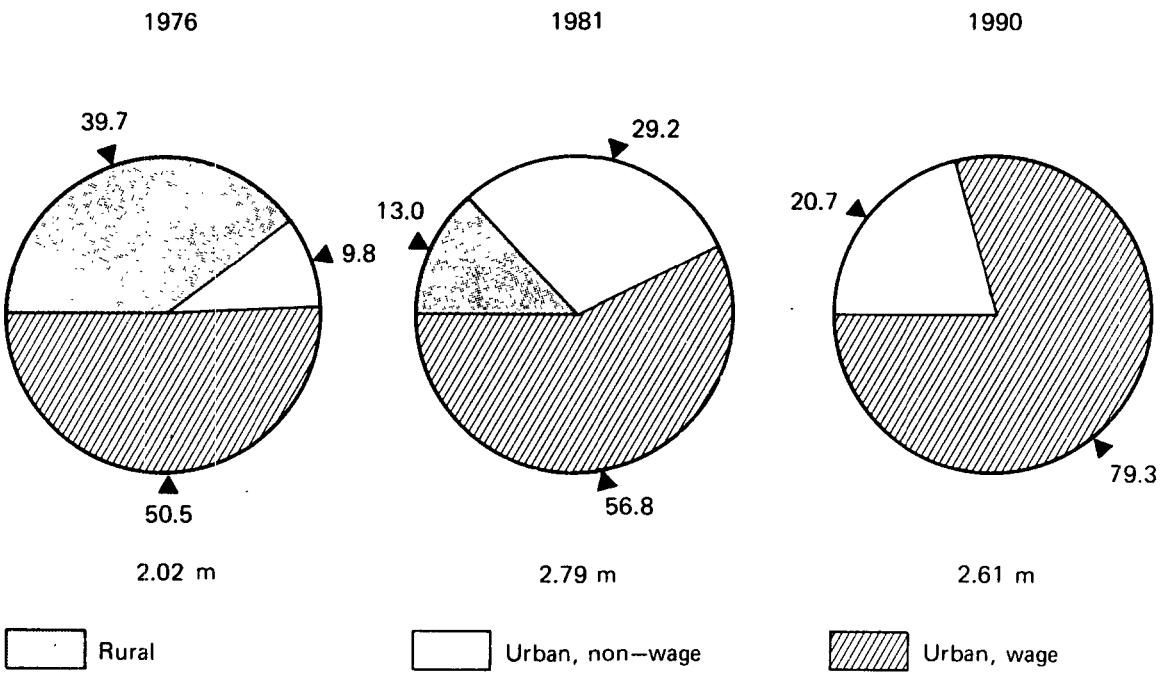


World Bank—16766

TABLE 6

Number of people below min. nutritional level and thier occupation composition:

CLOCKWISE



Corresponding to Model Sector classification

Occupation	1976	1981	1990
1. Rural	2	2	2
2. Urban Non–wage	14	14	15, 17
3. Urban wage	8, 12, 17	8, 17	8

World Bank–17260

TABLE 7

Income Distribution in Percentile Groups of Population, 1976–1990.

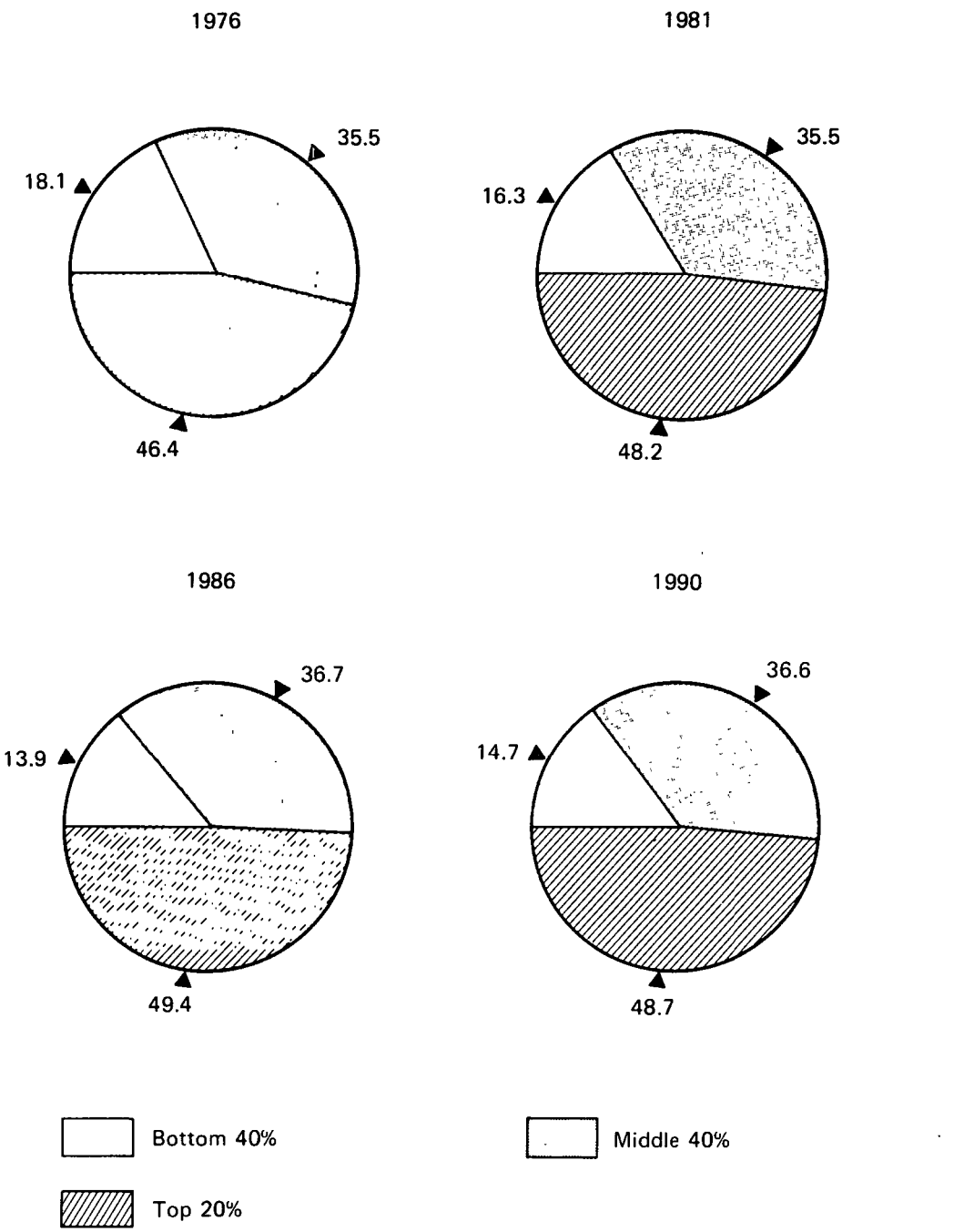


TABLE 8

90

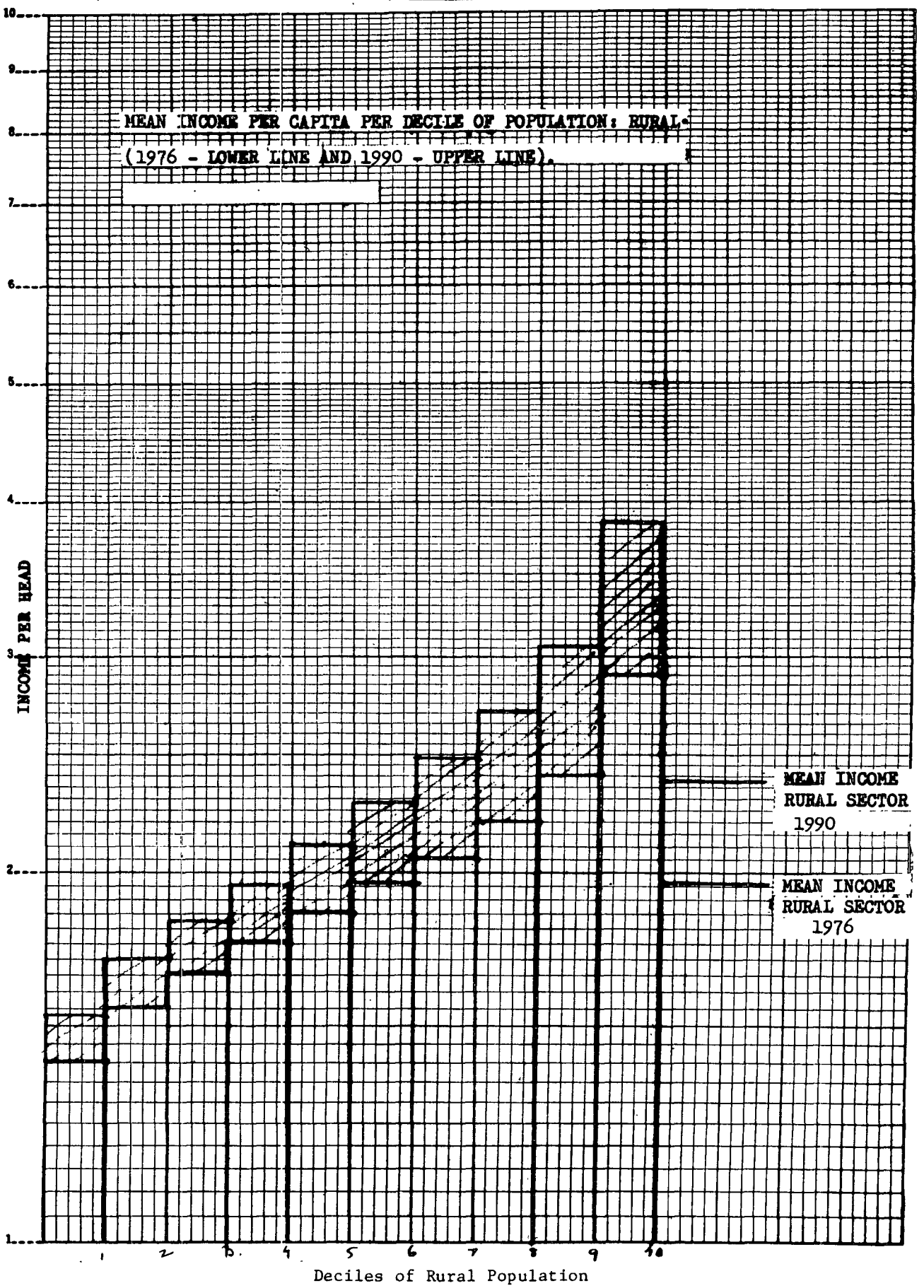

MEAN INCOME PER CAPITA PER DECILE OF POPULATION: RURAL.
(1976 - LOWER LINE AND 1990 - UPPER LINE).
INCOME PER HEAD
10
9
8
7
6
5
4
3
2
1
MEAN INCOME RURAL SECTOR 1990
MEAN INCOME RURAL SECTOR 1976
1 2 3 4 5 6 7 8 9 10
Deciles of Rural Population

TABLE 9

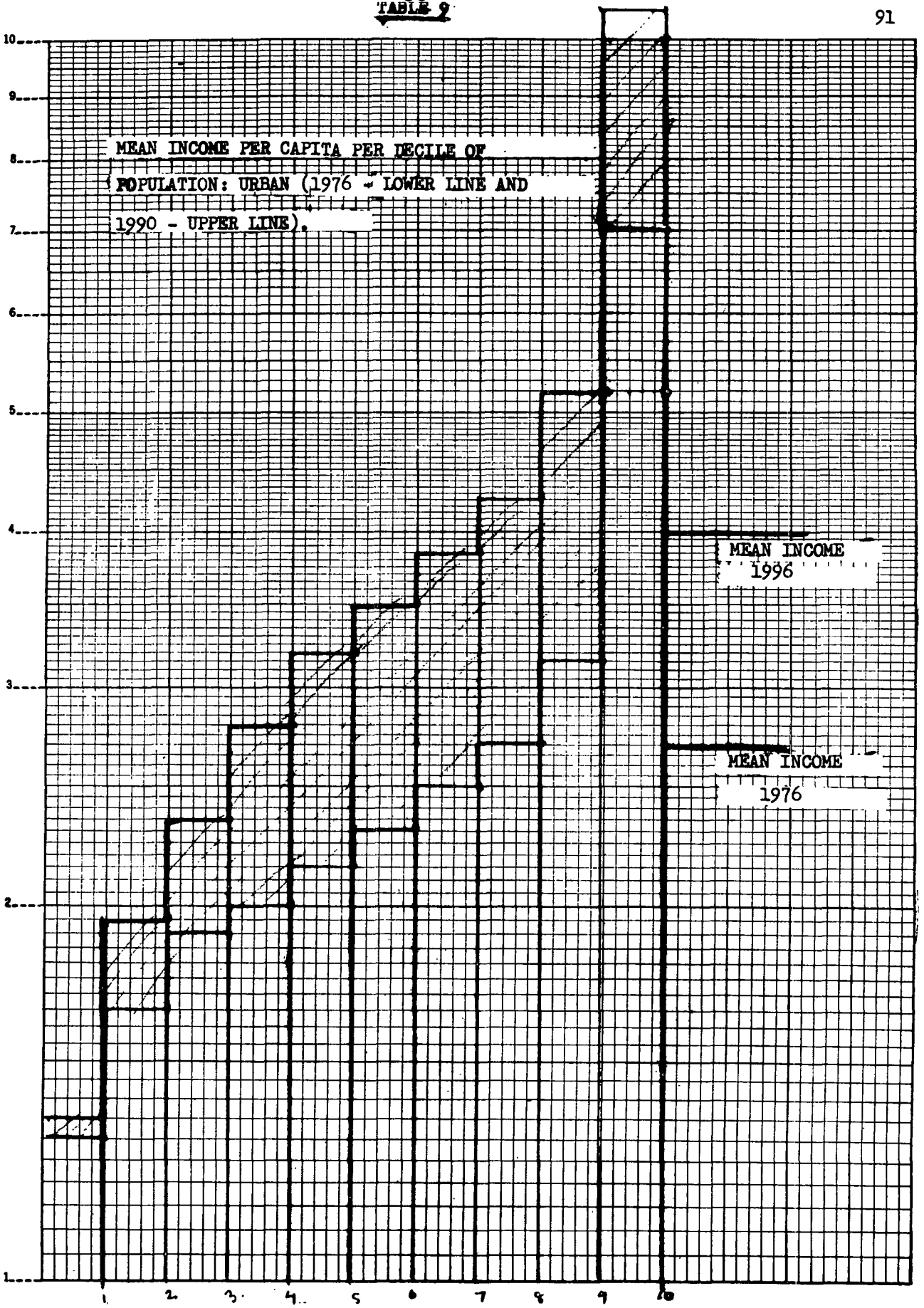

MEAN INCOME PER CAPITA PER DECILE OF POPULATION: URBAN (1976 - LOWER LINE AND 1990 - UPPER LINE).
MEAN INCOME 1996
MEAN INCOME 1976
10
9
8
7
6
5
4
3
2
1
1
2
3
4
5
6
7
8
9
10

TABLE 10

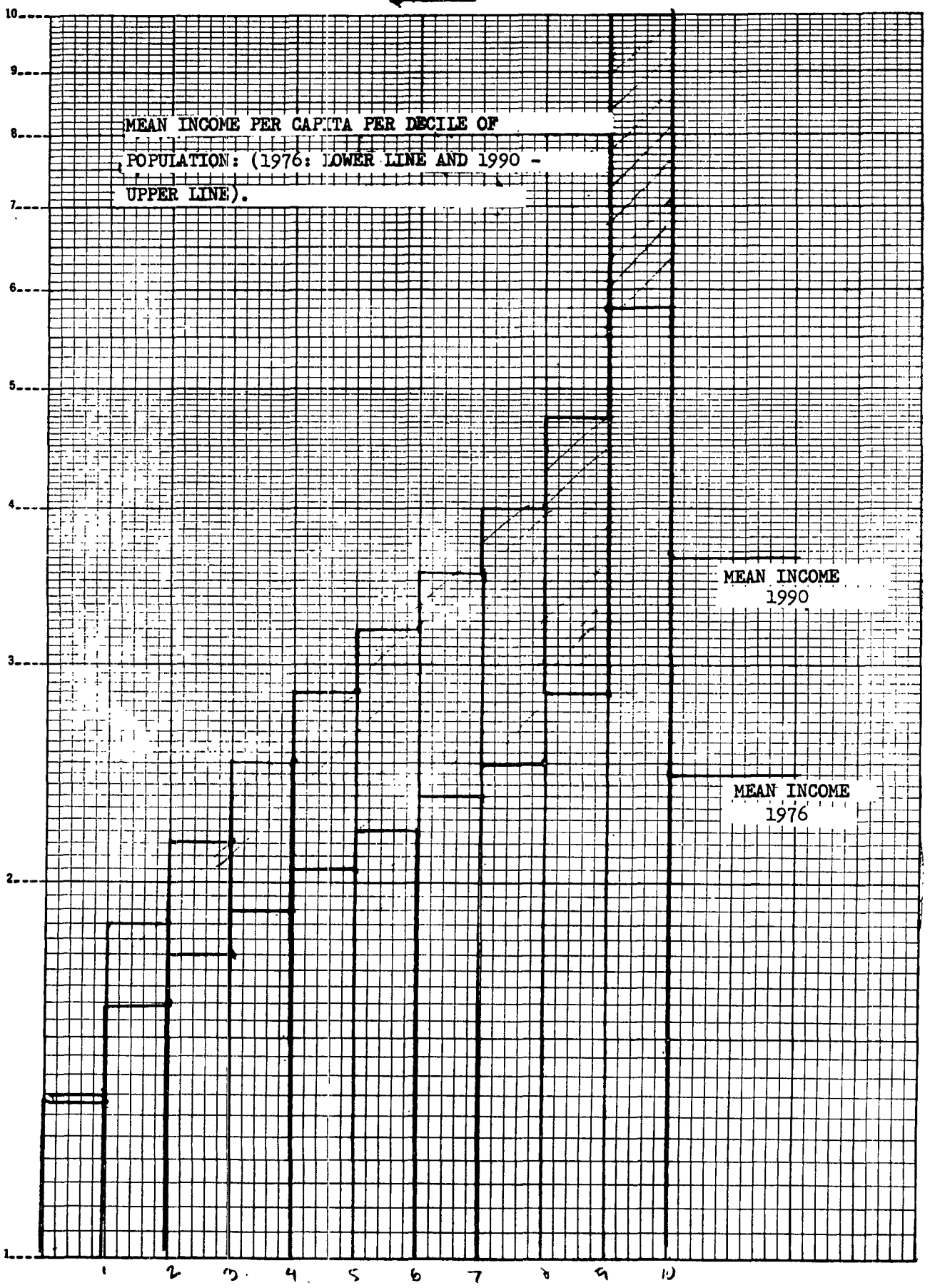

MEAN INCOME PER CAPITA PER DECILE OF POPULATION: (1976: LOWER LINE AND 1990 - UPPER LINE).
MEAN INCOME 1990
MEAN INCOME 1976
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10

TABLE 11

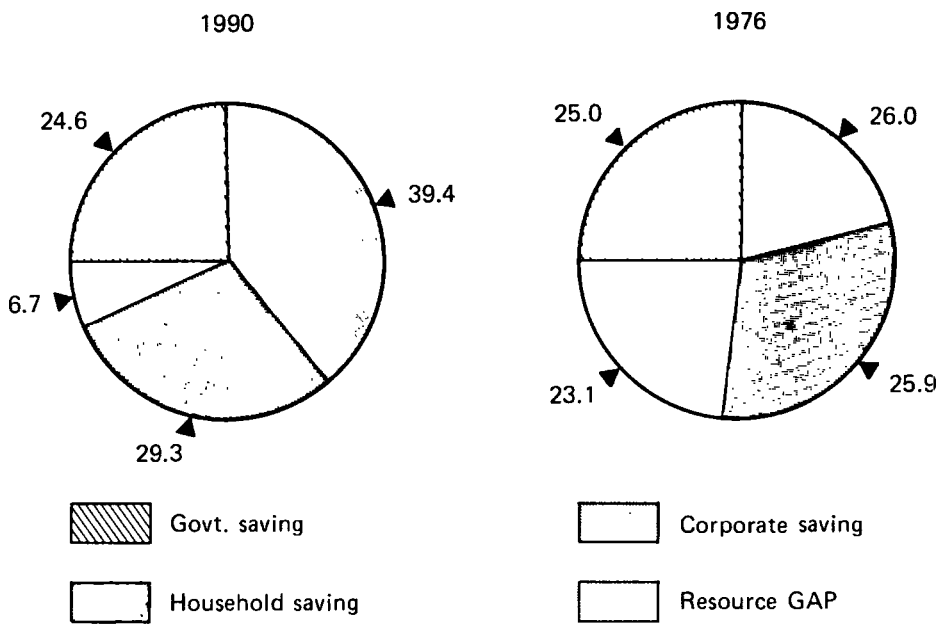
MAJOR MACRO VARIABLE ALTERNATES

NAME	Variable Nos. 1976	1981	1986	1990	Growth Rate 1976-81	Growth Rate 1981-90	Growth Rate 1976-1990
A. GNP							
1. GNP (Aggr)	10349	15987	24669	36417	9.08	9.58	9.4
2. i. Agri.%	22	16.9	12.7	9.7	3.5	3.0	3.2
ii. Manufacture %	27.6	32.9	35.1	36.6	11.3	10.9	11.6
iii. Services %	50.4	50.2	52.2	53.7	9.0	10.4	9.9
3. Per Capita Income $	594	841	1159	1614			
4. Bottom 40%	18.1	16.3	13.9	14.7			
5. Top 20%	46.4	48.2	49.4	48.7			
6. Poverty	3.02	2.79	4.94	2.61			
7. GINI	.387	.414	.445	.431			
8. Bottom 20	6.59	5.70	3.96	4.61			
B. CONSUMPTION							
1. Aggregate	8168	12350	18174	25844	8.6	8.6	9.3
2. Private	6776	9703	13912	19602			
3. Government	1392	2647	4264	6242			
4. Food grains	1146	1403	1653	1962	4.1	3.8	3.9
C. INVESTMENT							
1. Aggregate	2952	4648	8196	12041			
2. Composition							
i. Agriculture	5.6	7.3	5.5	4.2	9.5	11.1	
ii. Manufacture	29.9	29.5	30.4	30.8			
iii. Services	64.5	63.2	64.1	65.0			
iv. ICOR		3.14	3.24	3.25			
D. SAVINGS							
1. Aggregate							
i. F.S.	491	616	879	36			
ii. D.S.	2272	3915	7042	11210			
a) Private	1534	2776	5159	8247			
b) Public	738	1139	1883	2963			
c) MSR		(29.1)	(35.0)	(35.5)			

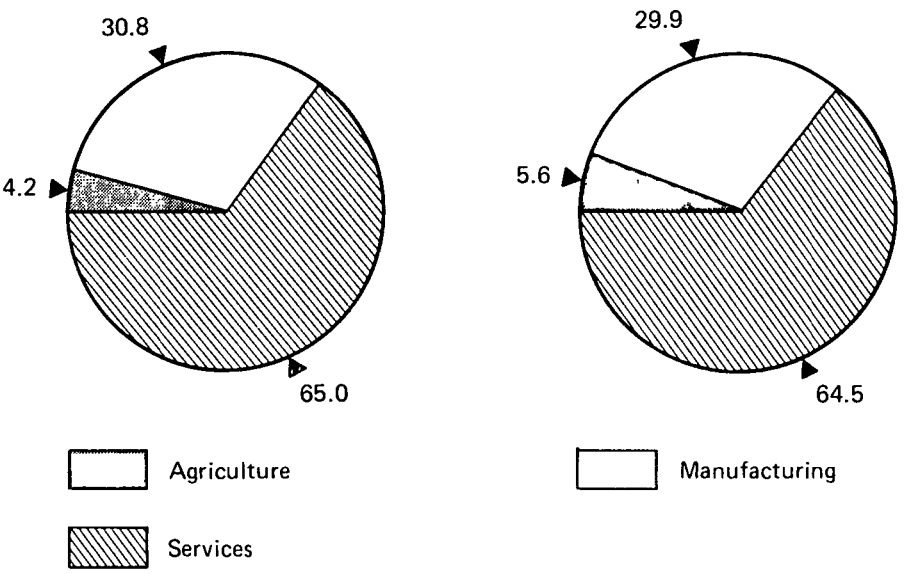
NAME	1976	1981	Variable Nos. 1986	1990	Growth Rate 1976-81	Growth Rate 1981-90	Growth Rate 1976-1990
E. EXPORTS							
1. Aggregate	3630	8488	17827	31180	18.5	15.6	16.6
2. Composition							
i. Agriculture	6.1	3.6	3.6	3.6			
ii. Manufacture	83.1	83.1	83.1	83.1			
iii. Services	10.8	13.3	13.3	13.3			
F. IMPORTS							
1. Aggregate	4309	9220	18981	32010	16.4	14.9	15.4
2. Agriculture %	26.8	24.5	22.6	23.1			
3. Manufacture %	68.9	69.1	71.0	72.3			
4. Services %	4.3	6.4	6.4	4.6			
G. DEMOGRAPHY							
1. Population	35.9	39.2	43.886	46.5	1.77	1.92	1.86
2. Working Force	12.7	14.9	17.210	18.9	3.25	2.68	2.88
H. EMPLOYMENT							
1. Aggregate	12.2	14.3	17.080	18.9	3.37	3.1	3.2
2. Sectoral							
i. Agriculture	5.5	5.6	5.733	5.8	.4	.4	.4
ii. Manufacturing	2.5	3.3	4.238	5.2	6.3	4.8	5.3
iii. Services	4.2	5.4	7.108	7.9	5.1	4.3	4.6
3. Unemployment	3.6	3.6	0.758	-			
I. MISCELLANEOUS							
1. Price	1.0	(1.392)		(2.240)	6.80	6.2	6.3
2. Debt Service Ratio	11.8	10.0		7.5			

TABLE 12
Saving and Investment: 1976 and 1990

a) SAVINGS



b) INVESTMENT



World Bank—17263

TABLE 13

MAJOR MACRO VARIABLE ALTERNATIVES (Low Growth)

NAME	Variable Nos. 1976	1981	1986	1990	Growth Rate 1976-81	Growth Rate 1981-90	Growth Rate 1976-1990
A. GNP							
1. GNP (Aggr)	10350	15497	22132	29722	8.4	7.5	7.8
2. i. Agriculture %	21.7	17.6	14.3	12.1	3.95	3.1	3.4
ii. Manufacture %	27.6	32.7	34.6	35.8	12.2	8.6	9.8
iii. Services %	50.7	49.7	51.1	52.1	7.9	13.2	8.0
3. Per Capita Income $	593	814	1039	1318			
4. Bottom 40%	18.06	16.34	13.25	12.40			
5. Top 20%	46.33	48.01	49.90	50.26			
6. Poverty	3	3	6	6			
7. GINI	.386	.413	.456	.466			
B. CONSUMPTION							
1. Aggregate	8113	11935	16502	22336	8.0	7.2	7.
2. Private	6722	9288	12239	16095			
3. Government	1391	2647	4263	6242			
4. Food Grains	1146	1373	1498	1646	3.6	2.0	2.6
C. INVESTMENT							
1. Aggregate	2721	3777	5425	7008	6.8	7.1	7.0
2. Composition							
i. Aggregate	6.1	8.3	7.0	6.3			
ii. Manufacture	29.7	29.1	29.7	29.8			
iii. Services	64.2	62.6	63.3	63.9			
iv. ICOR		3.1	3.2	3.16			
D. SAVINGS							
1. Aggregate							
i. F.S.	486	217	-202	-365			
ii. D.S.	2326	3800	5850	7432			
a) Private	1594	2736	4317	5270			
b) Public	732	1064	1533	2162			
c) MSR		28	21	30			

NAME	Variable Nos. 1976	1981	1986	1990	Growth Rate 1976-81	Growth Rate 1981-90	Growth Rate 1976-1990
E. EXPORTS							
1. Aggregate	3630	8488	17827	31179	18.5	15.6	16.6
2. Composition							
i. Agriculture	6.1	3.6	3.6	3.6			
ii. Manufacture	83.2	83.1	83.	83.1			
iii. Services	10.7	13.3	13.4	13.3			
F. IMPORTS							
1. Aggregate	4025	8465	17400	30755	15.5	15.4	15.6
2. Agriculture%	27.6	24.7	19.3	16.8			
3. Manufacture %	69.8	68.4	75.2	79.6			
4. Services %	2.6	6.9	5.5	3.6			
G. DEMOGRAPHY							
1. Population	35.9	39.2	43.886	46.5	1.77	1.92	1.86
2. Working Force	12.7	14.9	17.210	18.9	3.25	2.68	2.98
H. EMPLOYMENT							
1. Aggregate	12.189	14.150	16.23	18.24	3.0	2.86	2.92
2. Sectoral							
i. Agriculture	5.468	5.610	5.733	5.830	.5	.8	.5
ii. Manufacturing	2.527	3.273	3.968	4.626	5.3	3.9	4.4
iii. Services	4.193	5.261	6.535	7.788	4.6	4.45	4.5
3. Unemployment P.C.	3.646	4.841	5.663	3.473			
I. MISCELLANEOUS							
1. Price	2.2	3.049	4.090	5.103	6.7	5.9	6.2
2. Debt Service Ratio	12.5	9.8	5.3	2.5			

TABLE 14

GROSS OUTPUT, EXPORTS & IMPORTS OF KOREA (1977-1990)

(at 1975 prices)
(billion won)

	1977					1981					1990				
	GO	M	EXP.	E as % GO	M as % of D	GO	M	EXP.	E as % GO	M as % of D	GO	M	EXP.	E as % of GO	M as % of D
Agriculture	3248	1387	244	7.5	32	3800	2260	304	8.0	39	4960	7404	1114	22.4	65.8
Manufacturing	11550	3589	3787	32.8	32	18068	6063	7052	39.0	35	45791	23741	25892	56.5	54.0
Electrical Machinery & Steel Shipbuilding	5923	2984	1568	26.4	41	10440	4111	3300	31.6	37	29276	17170	12133	41.3	(49.0)
Services	8861	180	471	5.3	2.1	12822	880	1133	8.8	70	31252	872	4148	13.3	3.1
TOTAL:	23659	5156	4502	(19.0)	(21.0)	34690	9223	8484	(24.4)	(26.0)	82003	32017	31180	(38.0)	(38.9)
Separately for Food Grains	1488	75	3		4.9	1741	126	3		6.8	2272	498	9		18.0

GO = Gross Output
M = Imports
EXP or E = Exports
D = Demand

TABLE 15

IMPORT COMPONENT OF DEMAND AND IMPORT SUBSTITUTION RATE

	Index of Import/Demand Ratio		Index of Import/Gross Demand	
	1977-81	IMS	1977-1990	IMS
Agriculture	1.218	.983	2.06	1.114
Manufacturing	1.094	.884	1.687	.91
Machinery, etc.	.900	.727	1.195	.646
Services	1.500	1.212	2.0	1.08
Total	1.238	1.0	1.85	1.0

TABLE 16

VALUE ADDED & GROSS OUTPUT RATIO OF (1977-81)

Billion Won (1975)

	1977			1981			1990		
	GO	VA	VA/GO %	GO	VA	VA/GO %	GO	VA	VA/GO %
Agriculture	3248	2361	(72.6)	3800	2760	(72.6)	4960	3602	(72.6)
Manufacturing	11550	3428	(29.7)	18068	5365	(29.7)	45791	13590	(29.7)
Services	8861	5649	(63.8)	12822	8176	(41.8)	31252	19933	(63.8)
Total	23659	11438	(48.3)	34690	16301	(47.0)	82003	37125	(45.3)

TABLE 17

AVERAGE DISPOSABLE INCOME OF RURAL AND URBAN HOUSEHOLD

at 1976 thousand won

Year	Class	Per Capita Disposable Income of Household			% Composition Totaled	Per Capita Income of the Economy	Govt. Income per Capita	Corporate Income per Capita	Percent of Disposable Household Income to Total
		Rural	Urban	Total					
1976	Pop(m)	12	23.8	35.9	18.1				
	Bottom 40%	84	103	93					
	Mean	139	242	207	100.0	288	59	22	72
1981	Pop(m)	12.2	27.0	39.2					
	Bottom 40%	102 (4.0)	123 (3.6)	111 (3.7)	16.3				
	Mean	171 (4.2)	320 (5.7)	273 (5.8)	100	408	97	37	66.9
1990	Pop(m)	9.0	37.41	46.5					
	Bottom 40%	137 (3.6)	207 (5.1)	179 (4.8)	14.7				
	Mean	245 (4.1)	541 (5.9)	483 (6.2)	100	783 (7.4)	198 (9.0)	101 (11.5)	61.7

Brackets denote percent change per annum from 1976.

TABLE 18

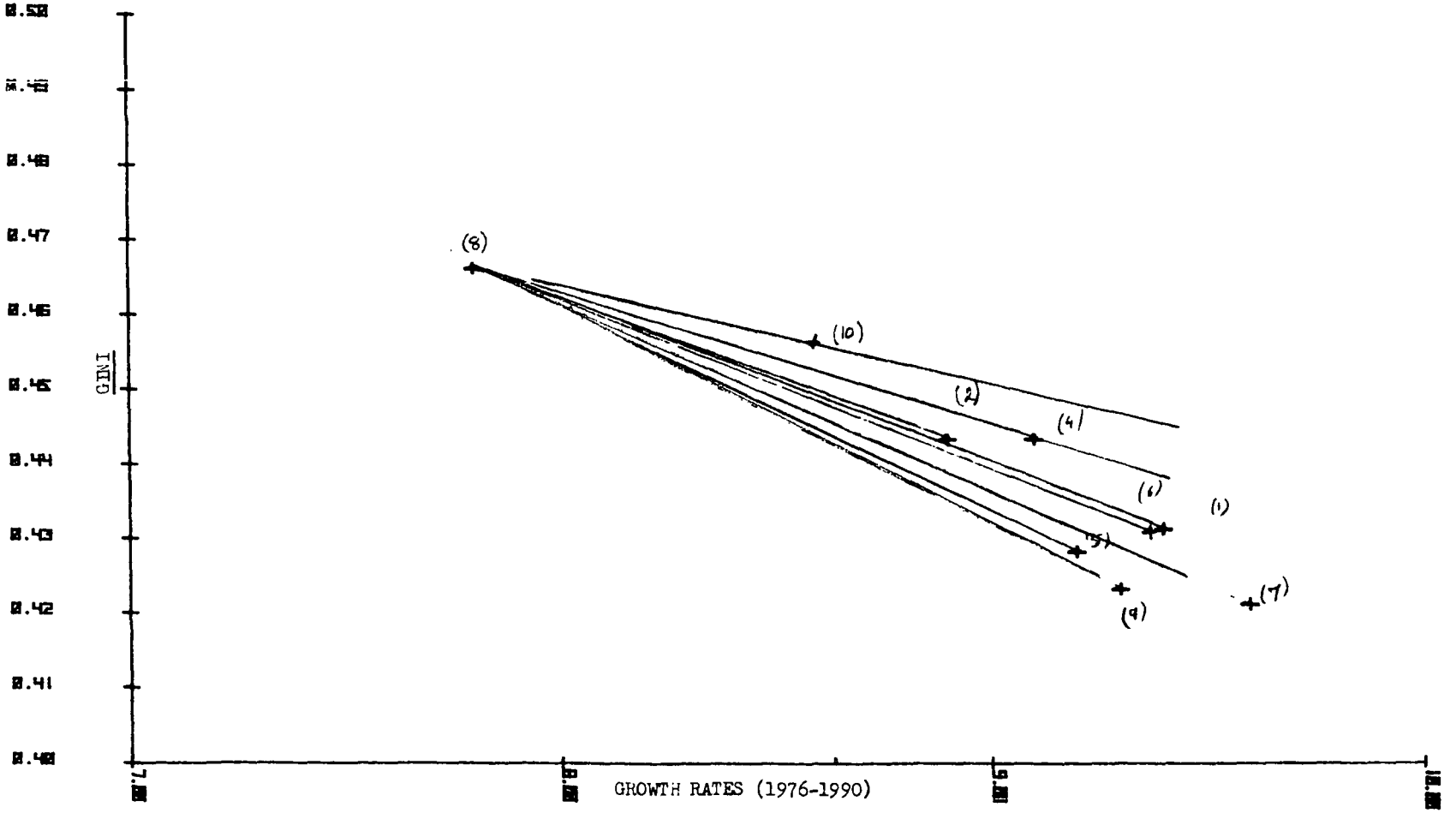


TABLE 19

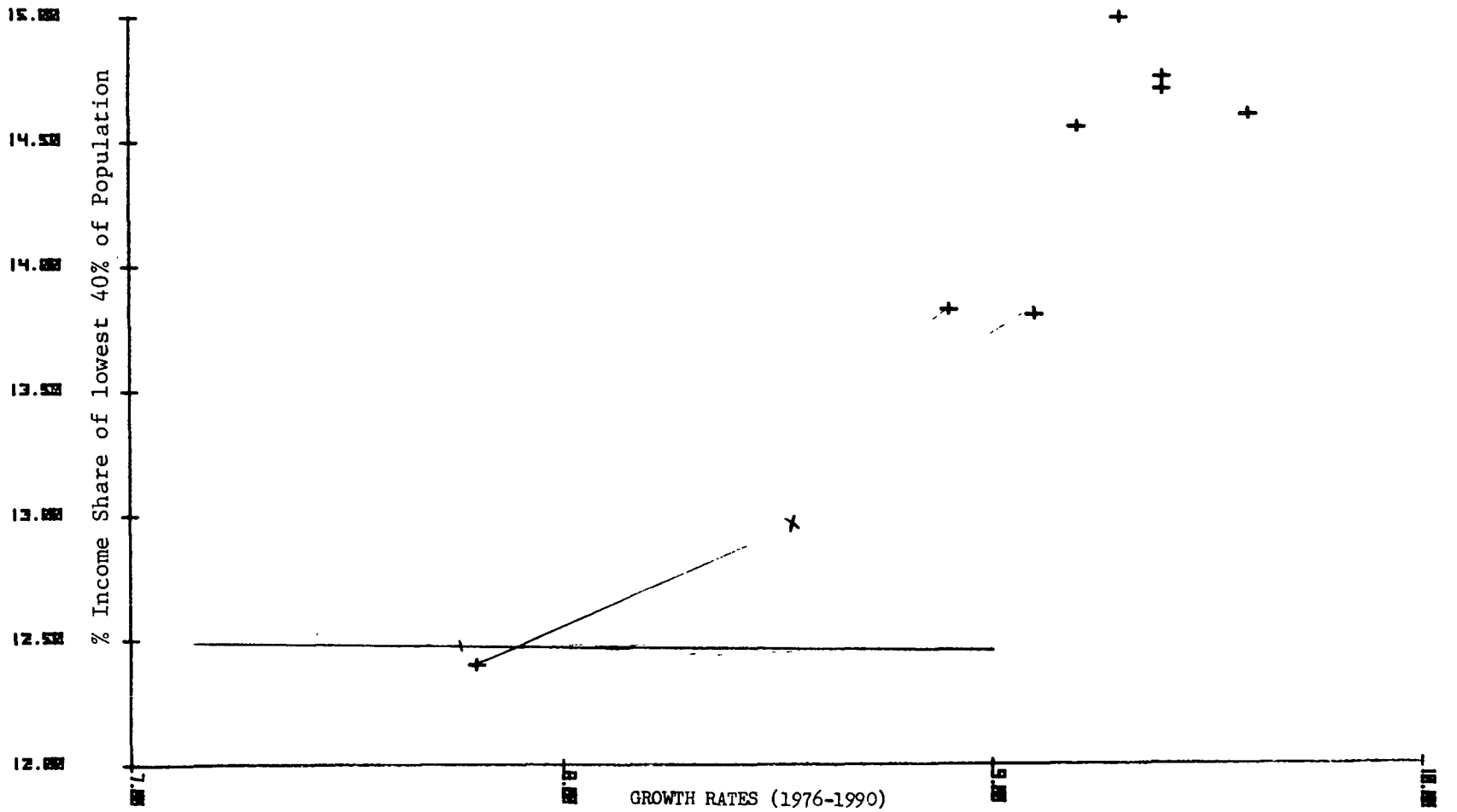

% Income Share of lowest 40% of Population
GROWTH RATES (1976-1990)

TABLE 20

Year	High Growth Case				Low Growth Case			
	GNP Billion 75 Won	GINI	Per Capita Income Below 40%	People below min. nutritional level	GNP Billion 75 Won	GINI	Per Capita Income Below 40%	People below min. nutritional level
1976	10351	.388	18.1	3	10351	.388	18.06	3
1981	16002	.418	16.3	3.2	15497	.413	16.34	3.4
1986	24830	.453	13.9	5	22132	.456	13.25	6
1990	37232	.421	14.7	2.8	29722	.466	12.40	6.3

Table 21

Years	GNP at 1975 Billion won	Unemployment rate %	Foreign Saving Billion 1975 Won	Population
1976	10349	4.61	491	35.91
1977	11324	5.05	604	36.54
1978	12440	5.0	455	37.18
1979	13568	5.2	303	37.85
1980	14709	5.5	282	38.53
1981	15930	5.7	214	39.25
1982	17253	5.9	125	39.99
1983	18698	6.0	29	40.76
1984	20276	5.8	-42	41.55
1985	22009	5.3	-131	42.36
1986	23917	4.9	-198	43.87
1987	26101	3.0	-270	44.02
1988	28540	1.0	-292	44.84
1989	31247	0	-339	45.66
1990	34289	0	-359	46.48

TABLE 22

Alternative Simulation No.	Simulation Nos.	Growth Rates 1976-1990	GINI	Bottom 40 % of Population
1	1	9.4	.431	14.7
2	2	8.9	.443	13.82
3	4	9.1	.443	13.80
4	5	9.2	.428	14.55
5	6	9.36	.431	14.75
6	7	9.6	.421	14.60
7	8	7.8	.466	12.40
8	9	9.3	.423	14.99
9	10	8.6	.455	12.95
	3*			

*3 has been dropped since it is identical with No. 7's results.

INPUT TABLES

INPUTS TO THE MACRO MODEL 1a

MACRO MODEL TABLE

THE 17 MACRO SECTORS

No.	Name	Corresponding in 53 Sector MOdel to: No.	Name
1.	Grains	Part of 1	Agriculture and Forestry
2.	Other Agriculture	Part of 1	Agriculture and Forestry
		2	Fishery
3.	Mining Including Oil	3	Coal
		4	Metallic Ores
		5	Non-Metallic Minerals
4.	Heavy Labor Intensive Export Oriented	34	Electronics
5.	Heavy Capital Intensive Export Oriented	23	Rubber Products
6.	Heavy Labor Intensive Domestic Oriented	32	Non-Electrical Machinery
		33	Industrial Electrical Machinery
		35	Household Electrical Machinery
		36	Shipbuilding and Repairing
		37	Railroad Transport
		38	Motor Vehicles
		39	Precision and Optical Products
7.	Heavy Capital Intensive Domestic Oriented	14	Pulp, Paper and Paper Products
		16	Inorganic Chemicals
		17	Organic Chemicals
		18	Chemical Fertilizers
		19	Synthetics
		20	Other Chemicals
		21	Petroleum Products
		22	Coal Products
		24	Cement
		25	Glass, Clay and Stone Products
		26	Iron and Steel
		27	Rolled Steel
		28	Steel pipes and Plated Steel
		29	Cast and Forged Steel
		30	Non-Ferrous Metals
		31	Metallic Products

Table 1a contd

Light Labor Intensive Export Oriented	9	Fabrics
	10	Finished Textiles
	11	Leather and Leather Products
	40	Other Manufactures
Light Capital Intensive Domestic Oriented	6	Processed Foods
	7	Beverage and Tobacco
	15	Printing Publishing
Light Labor Intensive Domestic Oriented	13	Wood Products and Furniture
Light Capital Intensive Export Oriented	8	Fiber Spinning
	12	Lumber and Plywood
Trade (retail and wholesale) Banking and Insurance	45	Banking and Insurance
	49	Commerce
Dwellings	46	Housing
Education, Health and Other Services, including Public Administration	50	Education
	51	Health
	52	Other Services
Transport and Communications	47	Communications
	48	Transport and Storage
Electricity	43	Electricity
	44	Water and Sanitary Services
Residence Buildings and Other Construction	41	Residence and Buildings
	42	Public and Other Constructions

MACRO MODEL TABLE 2a

Export and Import Price Indices

(f.o.b. $ 1973 = 1.00) (Assuming 3% shift in terms of trade in favor of Korea since 1944 (1973, 1974, 1975 and 1976, actual)

Years	PXD 1 - PXD 17 Export Prices	PMD 1 - PMD 17 Import Prices
1	1.0	1.0
2	1.384	1.649
3	1.565	2.070
4	1.752	2.152
5	1.841	2.329
6	1.932	2.441
7	2.028	2.563
8	2.129	2.691
9	2.235	2.825
10	2.346	2.966
11	2.463	3.114
12	2.586	3.269
13	2.715	3.432
14	2.850	3.603
15	2.992	3.783
16	3.141	3.972
17	3.298	4.170
Compound growth rate:	(7.6)	(9.1)

MACRO MODEL TABLE 3a

Non-competitive Intermediate Import Component of Output

Sector	Import Component
1	.001
2	.001
3	.010
4	.013
5	.204
6	.025
7	.129
8	.016
9	.042
10	0
11	.408
12	0
13	0
14	.005
15	.011
16	0
17	.005

TABLE 4a

(1) INCREASE OF EXPORTS: (mixed strategy Modern (4 & 6) and Traditional (8/both): Increasing 3% p.a. on Base in the Aggregate

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
SECTOR (4)	475	632	796	979	1155	1409	1719	2097	2558	3121	3807	4644	5666	6912
SECTOR (6)	446	607	801	1033	1322	1613	1968	2400	2928	3572	4358	5317	6486	7913
SECTOR (8)	1584	1948	2357	2805	3282	4004	4885	5960	7271	8871	10822	13203	16108	19652

Table 4a contd

(2) INCREASE OF EXPORTS: (Modern Sector Growth Strategy (4 & 6).

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
SECTOR (4)	494	687	906	1169	1450	1827	2302	2901	3655	4605	5802	7310	9211	11606
SECTOR (6)	465	660	911	1230	1648	2076	2616	3296	4152	5232	6592	8306	10465	13186
SECTOR (8)	1509	1765	2021	2274	2527	2931	3400	3944	4575	5307	6156	7141	8283	9608

MACRO MODEL TABLE 5a

Export Allocations by Sector and Totals

(Goods and non-factor services 1975 prices, billion Won)

Sectors	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982-90
1	0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.046	0.050	0.063	0.053	0.047	0.042	0.037	0.034	0.031	0.031
3	0.008	0.011	0.010	0.008	0.007	0.006	0.006	0.005	0.005	0.005
4	0.076	0.058	0.072	0.088	0.101	0.106	0.108	0.108	0.107	0.107
5	0.025	0.040	0.043	0.035	0.032	0.031	0.032	0.032	0.033	0.033
6	0.033	0.060	0.075	0.086	0.095	0.102	0.109	0.116	0.124	0.124
7	0.112	0.171	0.138	0.145	0.152	0.158	0.159	0.159	0.159	0.159
8	0.308	0.296	0.345	0.344	0.335	0.325	0.315	0.305	0.298	0.298
9	0.043	0.054	0.062	0.051	0.046	0.043	0.040	0.037	0.035	0.035
10	0.007	0.008	0.008	0.007	0.006	0.006	0.006	0.006	0.007	0.007
11	0.115	0.066	0.085	0.076	0.073	0.074	0.074	0.072	0.007	0.007
12	0.056	0.054	0.028	0.030	0.029	0.029	0.030	0.033	0.033	0.033
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.069	0.027	0.014	0.015	0.014	0.015	0.014	0.017	0.018	0.018
15	0.093	0.096	0.052	0.058	0.058	0.060	0.065	0.071	0.078	0.078
16	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
17	0.005	0.005	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Totals	1,576.04	2,402.6	2,733.2	3,630.0	4,505.9	5,439.3	6,426.3	7,450.6	8487.7	

	1982	1983	1984	1985	1986	1987	1988	1989	1990
Totals	9,845.7	11,421.1	13,248.5	15,368.3	17,827.1	20,501.2	23,576.3	27.112.8	31,179.7

Source:

MACRO MODEL TABLE 6a

Imports

(Goods 1973 prices, c.i.f., billion won)

Sector	1973 Imports
1	181.560
2	218.460
3	136.000
4	128.100
5	1.780
6	356.000
7	473.400
8	97.770
9	69.200
10	1.260
11	31.200
Total Goods	1,694.73

Source:

MACRO MODEL TABLE 7a

Export and Import Price Indices (Low Growth)

Years	(f.o.b. $ 1973 = 1.00) PXD 1 - PXD 17 Export Prices	(Assuming no terms of trade after 1975) PMD 1 - PMD 17 Import Prices
1 1973	1.000	1.000
2	1.384	1.649
3	1.565	2.070
4	1.643	2.174
5	1.725	2.282
6	1.812	2.396
7	1.902	2.516
8	1.997	2.642
9	2.097	2.774
10	2.200	2.913
11	2.312	3.058
12	2.427	3.211
13	2.548	3.372
14	2.676	3.540
15	2.810	3.717
16	2.950	3.903
17 1990	3.252	4.303
Compound growth:	(7.2)	(8.9)

MACRO MODEL TABLE 8a

LOW EXPORTS, at 1975 Billion Won

Sectors	1976-1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
8	Same as Medium Exports	2678.0	2839.0	3009.0	3190.0	3318.0	3450.0	3588.0	3732.0	3881.0
11	" "	627.0	665.0	704.0	747.0	777.0	808.0	840.0	874.0	909.0

TABLE 9a

High Exports, at 1975 Billion Won

Sectors	1976-1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
4	Same as Medium Exports	1149.0	1459.0	1853.0	2353.0	3059.0	3976.0	5169.0	6720.0	2736.0
6	"	1333.0	1693.0	2150.0	2730.0	3549.0	4614.0	5998.0	7797.0	10136.0

TABLE 10a

INTER-INDUSTRY FLOW MATRIX FOR KOREA - 1973

SECTOR \ DEMANDS	GRAINS	OTHER AGRI.	MINING	HLE	HKE	HLD	HKD	LLE	LKD	LLD	LKE	TRADE	DWELLING	SERVICES	TRANS-PORT	ELECT-RICITY	CONST-RUCTION
1. GRAINS	6.76	35.05	.00	0.00	0.00	.00	.04	3.38	113.31	0.00	0.00	.00	0.00	10.86	0.00	0.00	3.44
2. OTHER AGRICULTURE	10.26	90.20	4.77	.03	11.19	.20	4.66	12.76	201.37	4.71	192.11	.13	0.00	13.90	.02	.00	13.93
3. MINING	.02	.92	.11	.34	.02	.32	192.19	.64	1.81	.03	.04	.30	0.00	2.67	.03	3.91	13.13
4. HLE	0.00	.69	.74	113.78	.11	19.35	4.03	.59	.88	.03	.17	2.23	.01	13.27	12.72	2.55	44.89
5. HKE	.00	.31	.25	.57	1.33	3.86	.94	1.97	.89	.00	.15	1.58	0.00	.89	12.25	.01	.24
6. HLD	.04	3.42	1.39	.69	.26	42.99	6.19	4.87	2.49	.11	1.07	2.46	0.00	6.26	31.21	1.17	7.68
7. HKD	31.74	53.74	7.76	55.47	23.63	76.27	531.42	123.38	72.94	2.08	56.90	21.57	.03	77.72	80.77	25.79	224.17
8. LLE	.56	10.42	.58	.49	13.91	.91	3.57	185.37	7.37	.10	2.94	6.17	.01	18.42	2.50	.10	.54
9. LKD	38.62	50.03	.11	.24	.03	.27	10.12	9.15	158.45	.09	1.71	4.51	.02	95.77	2.99	.41	.23
10. LLD	.02	2.89	.05	.54	.08	.30	.42	.36	1.41	.12	.11	.36	0.00	.67	.10	.03	1.51
11. LKE	.00	.25	.06	1.69	2.26	1.47	2.73	168.52	.21	3.98	4.09	.78	0.00	7.84	.21	.08	44.01
12. TRADE	8.22	39.79	4.86	9.43	3.59	11.64	75.07	84.67	78.63	3.33	22.56	31.19	.54	72.02	46.66	10.29	60.49
13. DWELLING	0.00	0.00	.02	.04	0.00	.01	.01	.14	.24	0.00	.03	.00	0.00	0.00	.12	0.00	0.00
14. SERVICES	18.27	22.76	3.65	4.94	3.51	7.60	36.24	21.51	23.82	.66	6.54	71.74	.24	131.06	46.62	1.74	31.60
15. TRANSPORT	1.70	7.44	1.32	2.63	2.28	4.35	41.01	11.73	18.18	1.03	2.52	38.54	.11	37.26	31.82	2.97	24.21
16. ELECTRICITY	0.00	.24	3.78	1.69	2.30	2.19	33.43	11.93	11.76	.18	3.53	2.68	.03	10.37	1.77	5.10	.90
17. CONSTRUCTION	.37	.44	.23	.07	.03	.11	.60	.42	.38	.01	.03	4.51	25.34	12.07	1.39	1.43	.52

TABLE 10a contd

INTER-INDUSTRY FLOW MATRIX FOR KOREA - 1973

SECTOR \ DEMANDS	Private Consumption	Public Consumption	Fixed Investment	Δ Inventories	Exports	Imports CIF	M Duties	Gross Output	Total Inter-NC Imports	Total Final NC Imports	Total NC Imports	Total Comp. Imports
1. GRAINS	676.21	.8576	0.0	77.397	3.506	181.562	3.5194	780.6	-	-	-	185.0814
2. OTHER AGRICULTURE	394.59	1.619	17.03	37.847	74.126	218.465	5.677	826.2	184.9	8.0	192.9	31.242
3. MINING	4.241	.37	0.0	.5872	13.045	135.958	1.744	97.02	121.8	-.842	120.958	16.744
4. HLE	27.134	.5327	26.144	4.443	120.152	128.136	3.019	184.96	2.0	-	2.0	129.155
5. HKE	15.729	1.001	.001	.001	39.011	1.783	.3382	81.05	-	.0008	.0008	2.1204
6. HLD	33.41	3.772	411.11	14.547	51.789	356.014	19.315	331.227	15.7	66.775	82.472	292.857
7. HKD	158.05	16.76	1.623	23.335	175.289	473.39	40.426	1345.5	76.4	2.597	78.997	434.819
8. LLE	278.80	.99	2.67	1.202	484.753	97.771	.939	917.6	.89	.1112	1.002	97.708
9. LKD	630.03	11.41	0.0	11.573	68.102	69.205	7.1858	1016.2	41.5	-.2752	41.2248	35.166
10. LLD	2.436	.171	1.997	-.043	11.048	1.262	.1264	23.2	-	-	-	1.3884
11. LKE	8.47	.119	0.0	.381	181.381	31.191	.4933	396.86	-	-	-	31.6843
12. TRADE	449.69	12.807	53.21	6.593	88.462	2.493	0.0	1171.3	-	-	-	2.493
13. DWELLING	188.937	0.0	0.0	0.0	0.0	0.0	0.0	189.6	-	-	-	0.0
14. SERVICES	412.28	410.211	0.0	0.0	108.995	31.72	.184	133.21	-	-	-	31.904
15. TRANSPORT	256.95	14.96	2.6	1.883	147.006	22.795	0.0	629.7	-	-	-	22.795
16. ELECTRICITY	27.15	2.897	0.0	0.0	2.094	.051	0.0	123.0	-	-	-	.051
17. CONSTRUCTION	0.0	13.11	669.87	0.0	7.286	0.0	0.0	738.2	-	-	-	0.0
TOTAL:	3564.08	491.583	1186.255	179.746	1576.04	1751.796	82.967		443.215	76.366	519.551	1315.21

4 = Heavy labour intensive export oriented
5 = Heavy capital intensive export oriented
6 = Heavy labour intensive demand oriented
7 = Heavy capital intensive domestic oriented
8 = Light labour intensive export oriented
9 = Light capital intensive domestic oriented
10= Light labour intensive domestic oriented
11= Light capital intensive export oriented

TABLE 11a

MEDIUM EXPORTS, at 1975 Billion Won

Sectors	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	2.0	2.2	2.4	2.5	2.6	2.7	3.1	3.6	4.2	4.9	5.7	6.6	7.5	8.7	10.0
2	193.0	211.3	225.9	239.2	250.4	260.4	302.1	350.4	406.5	471.5	546.9	628.9	723.3	831.8	956.5
3	28.7	30.3	32.6	36.3	38.7	40.5	47.0	54.5	63.2	73.3	85.1	97.9	112.5	129.4	148.8
4	320.9	455.7	578.3	691.1	806.1	904.4	1049.1	1217.0	1411.7	1637.5	1899.5	2184.4	2512.1	2888.9	3322.2
5	127.6	144.6	166.6	202.8	239.7	277.8	322.2	373.8	433.6	503.0	583.5	671.0	771.7	887.4	1020.5
6	312.6	428.0	556.4	702.2	863.7	1049.4	1217.3	1412.1	1638.0	1900.1	2204.1	2534.7	2914.9	3352.2	3855.0
7	525.9	686.3	857.9	1020.9	1184.2	1350.0	1566.0	1816.6	2107.2	2444.4	2835.5	3260.8	3749.9	4312.4	4959.3
8	1247.1	1509.0	1765.5	2021.5	2274.2	2526.6	2930.9	3399.8	3943.8	4574.8	5306.7	6102.7	7018.1	8070.8	9281.5
9	186.6	208.4	231.5	255.3	277.5	293.3	340.2	394.7	457.8	531.1	616.0	708.4	814.7	936.9	1077.4
10	24.2	27.8	32.7	40.4	47.9	57.2	66.4	77.0	89.3	103.6	120.1	138.1	158.8	182.7	210.1
11	274.5	329.1	401.2	474.2	538.7	591.5	686.1	795.9	923.3	1071.0	1242.	1428.8	1643.1	1889.7	2173.0
12	110.0	131.5	159.4	194.2	242.7	279.0	323.6	375.4	435.5	505.2	586.0	673.9	775.0	891.2	1024.9
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	54.1	64.1	79.9	100.3	124.4	149.9	173.9	201.7	234.0	271.4	314.8	362.1	416.3	478.8	550.7
15	209.3	260.9	328.0	418.4	525.7	662.7	768.7	891.7	1034.4	1199.9	1391.9	1600.7	1840.8	2116.9	2434.4
16	3.8	5.0	6.8	9.5	12.6	16.6	19.3	22.3	25.9	30.1	34.9	40.1	46.2	53.1	61.0
17	9.9	11.7	14.2	17.5	21.5	25.7	29.8	34.6	40.1	46.5	54.0	62.1	71.4	82.1	94.4
Total:	3630.0	4506.0	5439.0	6426.0	7451.0	8488.0	9845.0	11421.0	13249.0	15368.0	17827.0	20501.0	23516.0	27113.0	31180.0

MACRO MODEL TABLE 12a

Macro Variables by Sector

(1973 values billion Won)

Sector \ Variable: Code Name	YN1 - YN 17 Value added by Sector	XN1 - XN 17 Gross Output by Sector	CPI 1 - CP 17 Private Cons. Expenditure	CG 1 - CG 17 Gov. Consumpt. Expenditure	IS 1 - IS 17 Invert. Demand by Source
1	633.000	745.000	676.000	0.860	0.000
2	484.000	788.000	395.000	1.600	17.000
3	64.000	93.000	4.200	0.370	0.000
4	53.000	177.000	27.000	0.530	26.100
5	16.000	77.000	15.700	1.000	0.001
6	90.000	316.000	33.400	3.800	411.000
7	384.000	1284.000	158.000	16.800	1.620
8	262.000	876.000	279.000	0.990	2.670
9	306.000	970.000	630.000	11.400	0.000
10	7.000	22.000	2.400	0.170	2.000
11	100.000	379.000	8.500	0.120	0.000
12	937.000	1117.000	450.000	12.800	53.200
13	156.000	181.000	189.000	0.000	0.000
14	783.000	1271.000	412.000	410.200	0.000
15	333.000	601.000	256.000	14.900	2.600
16	64.000	117.000	27.200	2.900	0.000
17	255.000	704.000	0.000	13.100	669.900
Total	4,927.000	9,718.000	3,563.400	491.540	1,186.091

Source: All variables based on National Accounts except investment based on Input/Output Tables.

TABLE 13a: ESTIMATES OF ICOR IN KOREA

	ICOR I/O	Total Gestation	Rates of Growth	Adjusted ICOR
1.	2.0	2	9.5	1.860
2.	2.67	2	7.5	2.484
3.	2.68	4	9.6	2.040
4.	.821	3	9.5	.711
5.	4.515	3	9.5	3.909
6.	2.615	3	9.5	2.264
7.	3.732	3	9.5	3.231
8.	1.083	2	9.5	1.008
9.	1.639	3	9.5	1.419
10.	1.369	2	9.5	1.273
11.	3.739	3	9.5	3.237
12.	.651	1	9.5	.651
13.	15.613	1	9.5	15.613
14.	2.329	1	9.5	2.329
15.	10.06	1	9.5	10.06
16.	16.622	3	9.5	14.392
17.	.614	1	9.5	.614

Adj. ICOR = $(ICOR)/(1+\gamma)^{t-1}$ when t = no. of years gestation and γ = rate of growth of total Investment. (In the projected period it lies between 7 and 8% p.a. in all cases).

MACRO MODEL TABLE 14a

Monthly Income and Expenditure for Urban Household

(% expenditure of total in four classes of salary and wage earners)

Sectors	Class I	Class II	Class III	Class IV
Total	1.0	1.0	1.0	1.0
1	.238	.163	.149	.111
2	.102	.119	.085	.125
3	.002	.001	.001	.001
4	.008	.009	.009	.009
5	0	0	0	0
6	.010	.010	.010	.011
7	.046	.048	.050	.052
8	.065	.068	.069	.074
9	.185	.192	.196	.209
10	0	0	0	0
11	0	0	0	0
12	.131	.129	.171	.137
13	.080	.057	.034	.023
14	.078	.118	.141	.149
15	.048	.080	.080	.094
16	.007	.006	.005	.005
17	0	0	0	0
Avg. Savings Ratio	-.071	.099	.146	.215
Dependency Ratio	3.52	3.81	3.99	4.22
Direct Tax Rate	.013	.018	.032	.050

Source: Based on Table 4-1: Annual Report on the Family Income and Expenditure Survey, 1974, EPB (BOS)

Note: Adjustments are made for broad class intervals in the model: per capita groupings p.a. into (0-50,000), (50,000-150,000), (150,000-250,000) and (250,000 and above). Also the valuation has been changed from purchasers' price to producers' price.

MACRO MODEL TABLE 14a contd.

Monthly Income and Expenditure in Rural Community

(% expenditure to total consumption by income given in Low classes)

Sector Total	Class I 0-1.0 4a	Class II 1.0-1.5	Class III 1.5-2.0	Class IV 2.0-above
1	1.0	1.0	1.0	1.0
2	.389	.361	.343	.254
3	.114.	.100	.100	.084
4	.001	.005	.005	.006
5	0	0	0	0
6	.005	.006	.004	.007
7	.023	.027	.024	.034
8	.106	.105	.109	.106
9	.118	.105	.096	.135
10	0	0	0	0
11	0	0	0	0
12	.065	.071	.084	.089
13	.089	.102	.105	.123
14	.046	.060	.076	.090
15	.024	.043	.041	.059
16	.015	.014	.012	.012
17	0	0	0	0
Average Savings Ratio	-.020	.242	.357	.353
Average Household Size	5.20	6.24	6.56	6.80
Dependency Ratio	2.0	1.92	2.0	1.88
Direct Tax Rate	.037	.016	.017	.025

Source: Table 2.1: Major Indicators of Farm Household Economy in Report on the Results of Farm Household Economy Survey (Ministry of Agriculture, 1975)

MACRO MODEL TABLE 15 a

Employment Elasticities

Sector	Wage	Non-Wage
1	-.048	-0.04
2	.3	0.25
3	.540	0.45
4	.540	0.45
5	.30	0.25
6	.54	0.45
7	.30	0.25
8	.60	0.50
9	.36	0.30
10	.60	0.50
11	.36	0.30
12	.60	0.50
13	.60	0.50
14	.60	0.50
15	.60	0.50
16	.192	0.16
17	.60	0.50

Source:

MACRO MODEL TABLE 16a

Ratio of "Self-Employed" to "Employees"

Model	Sectors (I/O Table)	#Workers	#Employees	Self-Employed	Self-Employed/Employees
One	1	2,445,200	197,600	2,247,600	11.3744
Two	2-6	2,358,800	428,700	1,930,100	4.5022
Three	7, 8, 9	109,000	106,350	2,650	.0249
Four	(.64)* 38	25,088	24,768	320	.0129
Five	31	24,600	24,400	200	.0081
Six	39, 40, 37, (.36)* 38.	94,312	91,032	3,280	.0360
Seven	22, 24-30, 32-26	245,250	234,400	10,850	.0462
Eight	17-19, 41	421,300	396,000	25,300	.0638
Nine	10-15, 23	270,200	245,150	25,050	.1021
Ten	21	20,900	15,100	5,800	.3841
Eleven	16, 20	86,800	85,300	1,500	.0175
Twelve	46, 50	1,219,900	305,700	914,200	2.9905
Thirteen	47	9,200	1,300	7,900	6.0769
Fourteen	51-56	1,165,300	808,500	356,800	.4413
Fifteen	48, 49	344,750	308,550	36,200	.1173
Sixteen	44, 45	16,900	16,900	zero	0.0
Seventeen	42, 43	355,000	339,00	16,000	.0471
	Total	9,212,500	3,628,750	5,583,750	1.5387

MACRO MODEL TABLE 17a

Employment, Wages and Productivity

(1973)

Sector	EW 1 - EW 17 Employment of Wage Earners	ENW 1 - ENW 17 Employment of Non-Wage Earners	W 1 - W 17 Wages by Sector	PY 1 - PY 17 Labor Productivity
1	0.204	2.13	157.200	2,649.000
2	0.555	2.495	134.300	745.000
3	0.114	0.003	386.100	615.000
4	0.083	0.001	345.100	855.000
5	0.050	0.001	215.600	432.000
6	0.177	0.006	341.400	677.000
7	0.396	0.015	374.600	1,297.000
8	0.639	0.036	178.500	573.000
9	0.384	0.032	349.300	1,066.000
10	0.025	0.008	239.600	368.000
11	0.167	0.002	263.400	820.000
12	0.305	1.212	511.000	2,708.000
13	0.002	0.012	558.800	7,800.000
14	0.914	0.405	598.000	942.000
15	0.411	0.048	346.800	890.000
16	0.029	0.001	457.900	2,370.000
17	0.386	0.019	498.300	726.000
Total	4.841	6.426	5,955.9	

IPL 1 - IPL 17 Index of Labor Productivity by Sector assumed 1 in 1973
IWR 1 - IWR 17 Index of Wage Rate by Sector assumed 1 in 1973

Sources:

TABLE 18a

ABSORPTION OF UNEMPLOYED LABOUR FORCE IN DIFFERENT SECTORS

Sectors	P.C. of Unemployed Absorbed
1	.3
2	.3
3	.05
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	.25
13	0
14	.1
15	0
16	0
17	0
Total:	100.0

TABLE 19a

INCOME DISTRIBUTION IN 1968

(Log variance of size distribution in different income classes)

Sectors	Rural Household	Urban Non-Wage Earners	Urban Wage Earners
1	.365	0	0
2	.365	0	0
3	.174	0	0
4	0	.742	.187
5	0	.742	.614
6	0	.742	.33
7	0	.742	.37
8	0	.742	.891
9	0	.742	.21
10	0	.742	.104
11	0	.742	.125
12	0	.449	.673
13	0	.449	.079
14	0	.449	.599
15	0	.449	.161
16	0	.742	.032
17	0	.449	.930

Source: Irma Adelman & Sherman Robinson, Korean Income Distribution Model

MACRO MODEL TABLE 20[a]

Share of labor productivity going to money wages		Effect of Price Changes on cost of living lagged one year	
Sector 1-17	80%	Sector 1-17	100%

Value Added Ratio (incl. indirect taxes)

Sectors	Ratio
1	.850
2	.614
3	.694
4	.302
5	.204
6	.284
7	.299
8	.300
9	.316
10	.290
11	.264
12	.838
13	.859
14	.616
15	.554
16	.548
17	.361

Source: Input/Output Tables

MACRO MODEL TABLE 21a

Ratios of Wage and Non-Wage Income to Gross Output

Sector	Ratio of Wage Income to Gross Output	Ratio of Non-Wage Income to Gross Output
1	.048	.799
2	.104	.503
3	.410	.279
4	.162	.140
5	.140	.064
6	.190	.094
7	.115	.184
8	.272	.028
9	.138	.178
10	.273	.017
11	.115	.149
12	.139	.697
13	.006	.853
14	.429	.187
15	.236	.321
16	.112	.436
17	.270	.091

Source: Input/Output Tables, 1973. KDI & BOK, Korea

MACRO MODEL TABLE 22a

Total Population and Working Population

(million)

	POPU Population	Working Age Population	WP Working Population (Labor Force)	
			Alt. I	Alt. II
1973	34.180		11.584	
1974	34.730		12.000	
1975	35.281	21.395	12.539	12.262
1976	35.907	22.075	12.935	12.652
1977	36.541	22.776	13.360	13.070
1978	37.183	23.435	13.803	13.508
1979	37.845	24.063	14.256	13.957
1980	38.531	24.688	14.712	14.408
1981	39.245	25.293	15.174	14.867
1982	39.989	25.906	15.651	15.340
1983	40.760	26.549	16.132	15.818
1984	41.553	27.201	16.609	16.292
1985	42.362	27.853	17.074	16.753
1986	43.184	28.487	17.531	17.206
1987	44.015	29.078	17.985	17.656
1988	44.843	29.654	18.430	18.096
1989	45.667	30.171	18.861	18.523
1990	46.484	30.699	19.272	18.931

Source: Bank Mission

MACRO MODEL TABLE 23a

Normalized Capital Coefficient Matrix - 1968: Korea

Sectors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	.089	.089	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	.089	.089	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	.298	0	.002	.002	.001	.034	.002	.002	.054	.045	.054	.030	.122	.117
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	.263	.263	.514	.250	.596	.517	.581	.500	.468	.405	.455	..217	.176	.220	.446	.381	:521
7	0	0	.012	.021	.024	.041	.011	.013	.015	.025	.007	.002	.006	.002	.001	0	.007
8	.005	.005	0	0	0	0	0	0	0	0	0	0	.002	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	.008	.020	.020	.027	.009	.007	.020	.011	.008	.001	.003	.001	.001	0	.005
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	.034	.034	.036	.037	.037	.037	.037	.037	.037	.037	.037	.037	.037	.037	.036	.037	.036
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	.519	.519	.430	.374	.322	.376	.360	.442	.426	.519	.790	.689	.731	.685	.486	.460	.315

Source: KDI, I/O TABLE, KOREA

MACRO MODEL TABLE 24a

Working Capital (1973)

Sectors	Change In Working Capital
1	77.400
2	37.800
3	0.590
4	4.440
5	0.001
6	14.550
7	23.340
8	1.200
9	11.570
10	- 0.043
11	0.381
12	6.590
13	0.000
14	0.000
15	1.880
16	0.000
17	0.000

Source: Input-Output Tables, 1973. KDI & BOK, Korea.

TABLE 25a

COMPARISION OF NOV' 75 & APR' 76 COEFFICIENTS, KOREA IV PLAN

	SECTOR	(Fix)ICOR APR' 76	NOV' 75
1.	Agriculture & Forestry	1.538	1.465
2.	Fishery	3.520	3.717
3.	Coal	3.512	2.069
4.	Mettallic Ores	1.396	1.551
5.	Non-Metallic Minerals	1.041	1.568
6.	Processed Foods	0.359	0.362
7.	Beverage & Tobacco	0.426	0.270
8.	Fiber Spinning	0.799	1.282
9.	Fabrics	0.257	0.726
10.	Finished Textiles	0.210	0.357
11.	Leather & Leather Products	0.206	0.403
12.	Lumber & Plywood	0.330	0.295
13.	Wood Products & Furniture	0.396	0.397
14.	Pulp, Paper & Paper Products	0.546	1.192
15.	Printing & Publishing	0.526	0.593
16.	Inorganic Chemicals	0.432	1.995
17.	Organic Chemicals	0.434	1.133
18.	Chemical Fertilizers	1.478	1.816
19.	Synthetic Resin & Chemical Fibers	0.615	1.286
20.	Other Chemicals	0.229	0.343
21.	Petroleum Products	0.185	1.257
22.	Coal Products	0.317	0.534
23.	Rubber Products	0.332	0.921
24.	Cement	0.944	2.733
25.	Glass, Clay & Stone Products	0.640	0.620
26.	Iron & Steel	0.951	1.278
27.	Rolled Steel	0.618	1.410
28.	Steel Pipes & Plated Steel	0.425	0.222
29.	Cast & Forged Steel	0.550	0.889
30.	Non-Ferrous Metals	0.396	1.354
31.	Mettalic Products	0.759	0.782
32.	Non-Electrical Machinery	0.838	0.804
33.	Industrial Electrical Machinery	0.688	0.499
34.	Electronics	0.292	0.248
35.	Household Electrical Machinery	0.688	0.392
36.	Shipbuilding & Repairing	0.206	1.461
37.	Railroad Transport	0.516	0.858
38.	Motor Vehicles	0.659	0.425
39.	Precision & Optical Products	0.264	0.447
40.	Other Manufacturing	0.243	0.337
41.	Residence & Building	0.049	0.082
42.	Public & Other Construction	0.322	0.537
43.	Electricity	6.968	8.074
44.	Water & Sanitary Service	19.056	7.008
45.	Banking & Insurance	0.690	0.430
46.	Housing	14.906	13.414
47.	Communication	5.486	2.771
48.	Transport & Storage	3.538	5.938
49.	Commerce	0.670	0.567
50.	Education	2.675	2.153
51.	Health	1.142	1.329
52.	Other Services	0.909	1.259
53.	Scrap & Unclassifiable	-	-

Source: KDI I/O Table 4/17/76 and Industry Division/ECD World Bank

MACRO MODEL TABLE 26a

OTHER GOVERNMENT REVENUES
(Billions Won)

	1973	1974	1975	1976	1977	1978	1979	1980	1981
At Current Price									
Non Tax Revenue	149.4	173.0	189.0	254.8	347.0	444.7	568.6	719.0	901.3
Enterprise Surplus	32.7	50.5	81.8	108.2	120.6	151.4	172.2	196.4	224.4
Local Taxes	74.1	108.0	148.0	186.4	266.4	326.6	401.6	481.5	578.4
Monoply Profits	57.0	69.0	135.5	178.0	209.7	245.9	311.9	387.9	473.2
Corporation Taxes	49.8	110.3	124.9	171.7	215.2	261.7	328.2	386.6	469.7
Other Direct Taxes	25.0	38.1	53.5	66.4	25.1	29.9	35.7		
Other Direct Taxes	25.0	38.1	53.5	66.4	25.1	29.9	35.7	42.4	50.5
Defense Taxes	--	--	57.7	224.6	289.8	343.0	405.6	479.9	566.3
Total:									
Add Taxes From Indirect Tax Base Changes	--	--	--	5.4	81.9	96.4	124.0	167.0	214.0
GDP Deflator (1973=100)	1.0	1.266	1.574	1.811	1.992	2.132	2.380	2.441	2.600
At 1973 Prices									
Grand Total:	388	433	502	659	760	867	995	1132	1283
Consumption at 1975 Price	856	983	1093	1228	1384	1575	1802	2056	2336
Consumption at 1973 Price	543	624	694	780	879	1000	1145	1306	1484

Source: Mission Estimates based on FFYP projections.

MACRO MODEL TABLE 27a

Tariff and Indirect Tax Rates

Sector	Tariff Rates	Indirect Tax Rates
1	0.019	0.003
2	0.026	0.007
3	0.013	0.005
4	0.024	0.049
5	0.190	0.005
6	0.054	0.027
7	0.085	0.039
8	0.010	0.007
9	0.104	0.085
10	0.100	0.027
11	0.016	0.026
12	0.000	0.035
13	0.006	0.208
14	0.000	0.020
15	0.000	0.052
16	0.000	0.100
17	0.000	0.006

Source: Input-output Table: Inter-industry Projection Model for Korea 1974-81. KIM Yoon Hyung (1975).

MODEL NOTATION

ALGEBRAIC FORMULATION OF THE MODEL

Variable Name

YNi = Net national output by sector

XNi = Gross national output by sector

GDPMP = GDP at market price

ISi = Investment demands by source by sector

IDi = Investment demands by destination by sector

RIi = Replacement investments by source by sector

RIDi = Replacement investments by destination by sector

WKi = Working capital by origin by sector

WKDi = Working capital by destination by sector

EWi = Employments of wage-earners by sector

ENWi = Employments of non-wage earners by sector

UN = Unemployment

PYi = Labor productivity by sector

RRIi = Rural real income by sector of 1, 2, & 3

RCL = Rural living cost index

RINCi = Rural income by income class of 1, 2, & 3

SRINCij = Sum of rural income in i-th sector by income class

Wi = Wage by sector

UWCL = Cost of living index of urban wage earners

RWi = Real wage rate by sector

UWPi = Urban per capital wage bill

UWINCi = Urban wage-earners income by income class

SUWINCij = Sum of urban wage-earners income by income class by sector

Fi = Final demand (intermediate, consumption, investment and export demand net of imports)

POP = Population

UNSi = Surplus labour allocated to a sector

ADR = Average dependency ratio (population to labour force ratio)

AIDR = Index of ADR

PRi = Population to labour ratio in sector i in an occupation household

UNWIi = Urban per capita non-wage earners' income

UNWINCi = Urban non-wage earners' income by income class

SNWINCij = Sum of urban non-wage earners' income by income class by sector

RDINi = Rural disposable income by income class

UWDINi = Urban wage-earners' disposable income by income class

UNWDINi = Urban non-wage earners' disposable income by income class

RSAVi = Rural savings by income class

UWSAVi = Urban savings of wage-earners by income class

UNWSAVi = Urban savings of non-wage earners by income class

HS = Household savings

CS = Corporate savings

GS = Gov't savings

GR = Gov't revenues

FS = Foreign savings

TS = Total savings

RCONi = Rural consumption by income class

UWCONi = Urban consumption of wage-earners by income class

UNWCONi = Urban consumption of non-wage earners by income class

RCNCij = Rural consumption by income class by sector

INDXi = Indirect tax rate by sector

*
GNONTAX = Growth rate of non-tax revenues

KSi = Composition of gov't consumption by sector

INTINCij = Non-competitive intermediate import coefficient matrix

MCCCij = Competitive import coefficient matrix

ELMPi = Import price elesticity by sector

PRi = Import price adjusted by import substitution by sector

IPIMi = Import price index by sector (c,i,f)

*
TRi = Import tax rate by sector

*
PMDi = Price index of imports (in U.S. dollars, f.o.b.)

IPLi = Index of labor productivity by sector

PIi = Labor productivity by sector

IWRi = Index of wage rate by sector

PDi = Prices by sector

IRCi = Index of capital returns by sector

IPCi = Index of capital productivity by sector

UNITWi = Unit wage-bill

UNITNWi = Unit non-wage bill

UNITIMi = Intermediate import component of unit gross output

UNITITi = Indirect tax rate per unit output

PXDi = Price index of exports (in U.S. dollars, f.o.b.)

* Asterisks (originally on parameters) have been connected to endogenous variables

$\overset{*}{RPi}$ = Growth rate of net national output for the exogenous sector

Bi = Matrix of investment gestation lags by sector

ALFAi = Value-added ratio

BBij = Distribution matrix of fixed capital-output coefficients

BWKij = Distribution matrix of fixed working capital-output coefficien

$\overset{*}{ELWi}$ = Labor elasticity of wage earners for value added sector won

$\overset{*}{ELNWi}$ = Labor elasticity of non-wage earners for value added per secto

EW1 = Wage elasticity with respect to labor productvity

EW2 = Wage elasticity with respect to cost of living for urban wage-earners

RDTRi = Direct tax rate for rural income class, i.

UWDTRi = Direct tax rate for urban wage-income class, i.

UNWDTRi = Direct tax rate for urban non-wage income class, i.

RSRi = Savings ratio of rural income class, i.

UWSRi = Savings ratio of urban wage-income class, i.

UNWSRi = Savings ratio of urban non-wage income class, i.

$\overset{*}{PCFS}$ = Foreign savings ratio

RHij = Rural consumption basket by i-th sector by j-th income class

UHij = Urban consumption basket by i-th sector by j-th income class

$\overset{*}{ICORi}$ = ICOR by sector

$\overset{*}{LAMDAi}$ = Investment allocation coefficients by sector

WKOR = ICOR of working capital by sector

DELTA = Parameter for replacement investments with respect to net output

$\overset{*}{IINDT}$ = Index of indirect tax rate

Notations: -

WP = Labour Force (i.e. working population adjusted by participation ratio)

ENT = Total wage earners

ENWT = Total non-wage earners

TOTEMP = Total employment

AVWG = Average wage for wage earners

OUTM = Out migration ratio

NA = Non-agriculture output

FP = Rural population (i.e. agriculture & mining)

UU = Urban unemployment

RU = Rural unemployment

AGREMP = Employment in agriculture

CSS = Incidence of corporate sector in ith income class

INDTS = Indirect tax incidence on the ith income sector

PSS = Incidence of additional saving in the ith income class

PADTX = Incidence of "other taxes" on ith income class

GAMMA = Incidence ratio of non-tax & customs duty in ith income class

UNS = Unemployed labour force allocation in a sector

COPE = Elasticity of corporate saving

RSB = Resource Balance at current won

ASPS = Additional savings effort in household sector

PVSAV = Private saving at 1975 price

SAVCOR = Corporate saving at 1975 price

GASHSD = Household saving at 1975 price

rnontax = Rate of growth of non-tax revenue

E_1 = Minimum targeted export

ELNFS = Export including non-factor service

MLNFS = Imports including non-factor service

DDA = Domestic demand, agriculture sector

DDMN = Domestic demand, mining sector

DDMG = Domestic demand, manufacturing sector

DDSS = Domestic demand, services

IMSA = Import substitution agriculture

IMSMN = Import substitution mining

IMSMG = Import substitution manufacturing

IMSS = Import substitution services

TIMS = Total import substitution

HIMSMG = Total import manufacturing

RG = Reserve Gap

PEE = PXD

PMM = PMD

EXPR = Aggregate export price in dollars

IMPR = Aggregate import price in dollars

CURBAL = Current account balance in dollar

NETDFI = Net direct foreign investment in dollar

NETPUB = Net public disbursements

NETOLT = Net other long-term disbursements

SHTERM = Short-term capital movement

NETIMF = Net IMF disbursements

CAPNEI = Capital not else when specified

CHGRES = Change in reserves

NETFSY = NET factor service income

RA = Resource availability

NSS = National savings at 1975 price

FSS = Foreign savings at 1975 price

DSIT/X = Debt service ratio at current dollar

GDPDEF = GDP deflator

RUNPER = Rural unemployment in percent

UUNPER = Urban unemployment in percent

EMMM = Employment in mining & manufacturing

MSTPR = Import percent for GNP at 1975 price

PASDR = Gross domestic saving percent at 1975 price

TIDR = Total investment rate percent at 1975 price

RGPR = Resource gap as percent of GNP

STRA, SNET, STAD, GNSG, GNSE, GDSH, GDSA = all with suffix PR expresses as percent of GNP at 1975 price

DTT, INDTT, CUSTDD = Direct, indirect tax, custom duty, other taxes and government revenue, all at 1975 prices

GSS = Government saving at 1975 price

NSPR = National saving

ETPR = Export as percent of GNP at 1975 price

CCGDP = Gross domestic product at market price less terms of trade changes

CGNP = GNP at 1975 prices

CNSFSY, CNETRN = As net factor service and net transfer all at 1975 prices

DEXPRT, DMPRT = Exports and imports at dollar (current) price

UWCNCij = Urban consumption of wage-earners by income class by sector

UNWCNCij = Urban consumption of non-wage earners by income class by sector

CPi = Private consumption by sector

TI = Total investments

IDi = Investment demands of destination by sector

RESI = Residual investments

DT = Direct taxes

INDT = Indirect taxes

NONTAX = Non-tax revenues

CUSTD = Custom duties

GS = Gov't savings

CGT = Total gov't consumption

CGi = Gov't consumption by sector

MSi = Imports supplied (required) in the material balances by sector (ex-post)

MDi = Imports demanded (ex-ante)

INTNCMi = Intermediate imports of non-competitives by sector

MCCi = Competitive imports of intermediate inputs by sector

MCi = Competitive imports by sector

MSUBi = Competitive imports substitutable by sector

Ei = Exports by sector

Di = Domestic demand by sector

ESHAR = (E) Export Shares

ENSHAR = (EN) Export Shares

EXPRB = Export price index

IMPRB = Import price index

PEE = Export price index

PMM = Import price index

EEXCH = Exchange rates

IEEXCH = Index of exchange rates

MODEL SYSTEM

Production Block

$$YN_i = YN_{i,\,t-1}\ \overline{RP_i} \qquad i = 1, 2, 3$$

$$YN_i = YN_{i,\,t-1} + \overline{B_j}\ (ID_{i,\,t-1} + \quad + ID_{i,\,t-4}) \qquad i = 4, \ldots\ldots\ldots\ 17$$

$$XN_j = YN_i/Alfa_i \ \ldots\ldots\ldots \qquad i = 1 \ldots 17$$

$$GDPMP = \sum_{i=1 - \ldots 17} YN_i$$

INVESTMENT BY SOURCES

$$IS_i = \sum_{j=1\ldots,17} \overline{BB}_{ij} \ldots ID_j \qquad i = 1, \ldots 17$$

$$RI_i = \sum_{j=1\ldots.17} \overline{BB}_{ij}\ RID_j \qquad i = 1, \ldots 17$$

$$WK_i = \sum_{j=1\ldots 17} \overline{BK}_{ij}\ KD_j \qquad i = 1, \ldots 17$$

INVESTMENT BY DESTINATION

$$TI = TS$$

$$IDi = \overline{IDi} \qquad i = (1, 2, 3)$$

$$WKDi = IWKOR\ (XNi - XNi,t\text{-}1) \qquad i = 1, \ldots., 17$$

$$RIDi = \overline{DELTAi} * YNi \qquad i = 1, \ldots., 17$$

$$RESI = \Sigma WKD_i - \Sigma RID_i - \Sigma ID_i \ (i = 1 \nearrow 3) + \Sigma (EN_i - E_i) * ICOR_i * ALTA_i$$

$$ICOR = \widetilde{ICOR}$$

$$ID_i = LAMBDA_i * RESI - (EN_i - E_i) * ICOR_i * ALFA_i$$

where i = 4 & above

(8) $$\frac{EN_i - EN_{i,t-1}}{EN_{i,t-1}} = \overline{ELW_i} * \frac{YN_i - YN_{i,t-1}}{YN_{i,t-1}}$$

$i = 1, \ldots, 17$

(9) $$\frac{ENW_i - ENW_{i,t-1}}{ENW_{i,t-1}} = \overline{ELNW_i} * \frac{YN_i - YN_{i,t-1}}{YN_{i,t-1}}$$

$i = 1, \ldots, 17$

(10) $$UN = \overline{WP} - \sum_{i=1 \ldots 17} (EN_i + ENW_i)$$

(11) $$PY_i = YN_i / EN_i \quad \ldots\ldots \quad i = 1, \ldots, 17$$

(12) $$POP = POP_{t-1} * (1 + \hat{r})$$

(13) $$UNS_i = UN * UNAC_i \qquad i = 1, \ldots, 17$$

(14) $$ADR = POPU/WP$$

(15) $$AIDR = ADR_t / ADR_o$$

(16) $$DR_i = DRi * AIDR$$

(17) $$WP = \tilde{WP}$$

(18) $$ELW_i = \overline{ELW_i}$$

(19) $$ELNW_i = \overline{ELNW_i}$$

(20) $$EWT = \sum_i EW_i$$

(21) $$ENWT = \sum_i ENW_i$$

(22) $$TOTEMP = ENT + ENWT$$

(23) $$AVWG = (\Sigma W_i * EN_i) / EWT$$

(24) $$OUTM = 8.82 * (NA/_{NA(-1)} - 1) + 12.946 * (NA(-1)/_{NA1-2} - 1) - .349$$

(25) $$FP = (1.0 - OUTM) * (WP/WP1-1)) * FP(-1)$$

(26) $$UU = WP - FP - EN_i - ENW_i \qquad i = 4 - 17$$

(27) $$AGREMP = \Sigma EWT + \Sigma ENWT \quad (i = 1, 2)$$

INCOME DISTRIBUTION BLOCK

$$RRI_i = (CSS_2 * YN_i - PSS_2 * YN_i - PADTX * YN_i - INDTS_i - GAMMA_i * (NONTAX + CUSTD)) / ((EW_i + ENN_i) * DR_i + UNS_i))$$

$$i = 1, 2, 3.$$

Lognormal income distribution, with given variance gives total income earned in sector i by class c; then:

$$RINC_c = \sum_{i=1, 2, 3} SRINC_{ic}$$

$$\frac{W_i - W_{i\ t-1}}{W_{i,\ t-1}} = \overline{EW_i} * \frac{PY_i - PY_{i,\ t-1}}{PY_{i,\ t-1}} + EW_2 * \frac{UNCL - UNCL_{t-}}{UNCLt-1} * .06/UN.PERCENT$$

$$i = 4, \ldots 17$$

$$RW_i = W_i / UNCL$$

$$UNI_i = RW_i / \overline{DR_i}$$

Lognormal distribution, with given variance, then:

$$UNINC_c = \sum_{i=4, \ldots 17} SUNINC_{ic}$$

$$UNWI_i = \frac{YNi * PD_j - EW_i * W_i}{ENN_i + UNS_i} * \frac{1}{DR_i} * \frac{1}{UNCL}$$

$$i = 4, \ldots, 17$$

Lognormal distribution, then:

$$UNWINC_c = \sum_{i=4 \ldots 17,} SNWINC_c \qquad c = 1, \ldots 4.$$

$$RDIN_c = RINC_c (1 - RDTR_c) \qquad c = 1, \ldots 4.$$

$$UWDIN_c = UWINC_c (1 - UWDTR_c) \qquad c = 1, \ldots 4.$$

$$UNWDIN_c = UNWINC_c (1 - UNWDTR_c) \qquad c = 1, \ldots 4.$$

$$RSAV_c = RDINC * RSR_c \qquad c = 1, \ldots 4.$$

$$UWSAV_c = UWDIN_c * UWSR_c \qquad c = 1, \ldots 4.$$

$$UNWSAV_c = UNWDIN_c * UNWSRc \qquad c = 1, \ldots 4.$$

$$HS = \sum_{c=1 \ldots 4} (RSAV_c + UWSAVc + UNWSAV_c)$$

$$\frac{CS - CS(-1)}{CS(-1)} = COPE * \frac{GDPFP - GDPFP(-1)}{GDPFP(-1)}$$

$$GS = CR - CCT$$

$$PCFS = (RSB/PHM) + ET * \left(\frac{PEE}{PMG} - 1\right)$$

$$TS = HS + CS + GS + FS + ASPS$$

$$CSSS = 1 - CS/GDPFC$$

$$COPE = 1.37 * (ET/ET(-1))$$

$$DS = HS + CS + GS + ASPS$$

$$PVSAV = GDSCOR + GDSHSD + GDSADS \quad \text{(At 1975 price.}$$

$$ASPS = \widetilde{ASPS}$$

CONSUMPTION BLOCK

$$RCCNc = RDINc\ (1 - RSRc) \qquad c = 1 \ldots 4.$$

$$UWCCNc = UWDINc\ (1 - UWSRc) \qquad c = 1 \ldots 4.$$

$$UNWCCNc = UNWDINc\ (1 - UNWSRc) \qquad c = 1 \ldots 4.$$

$$RCNCc,i = RHi,c\ RCCNc \qquad c = 1 \ldots 4.,\ i = 1 \ldots 17.$$

$$UNCNCc,i = UHi,c * UWCCNc \qquad c = 1 \ldots 4.,\ i = 1 \ldots 17.$$

$$UNWCNCc,i = UHi,c * UNWCCNc \qquad c = 1 \ldots 4,\ i = 1 \ldots 17.$$

$$CPi = \sum_{c=1, \ldots 4,} RCNCc,i + UWCNCc,i + UNWCNCc,i$$

$$C = \Sigma\ CP_i + \Sigma\ CG_i$$

PUBLIC FINANCE

$$DT = \sum_{c=1,..,4} (RINc * RDTRc + UNTINCc * UNDTRc + UNWINCc * UNWDTRc)$$

$$INDT = \sum_{i=1...17} XNi * \overline{INDX} * \overline{INDT}$$

$$NONTAX = NONTAX(-1) * (1 + \gamma_{nontax})$$

$$CUSTD = \sum_{i=1,...,17} MSi * TRi$$

$$GR = DT + INDT + NONTAX + CUSTD + ADTX$$

$$CGT = \widetilde{CGT}$$

$$CGi = \widetilde{KSi} * CGT \qquad i = 1, ..., 17$$

$$ADTX = \overline{ADTX}$$

$$ASPS = \overline{ASPS}$$

PRICE BLOCK

$$PDi = \sum_{j=1\ldots17} AINV_{ij} \left[UNITN_i * \frac{TOTEM}{YN_i} * \frac{YN_o}{TOTEMP_o} * IWR_i \right.$$

$$+ (UNITNM_i + UNITW_i - UNTTW_i * \frac{TOTEMP}{YNi} * \frac{YNo}{TOTEMP_o})$$

$$* IRC_j + (UNITIM_i * IPIM_i * (MT/GDPFC)/(MT_o/GDPFC_o))$$

$$\left. * IEEXCH + UNITIT_i * IINDT \right]$$

$$JPLit = PYit / PYio \qquad i = 1,\ldots,17$$

$$IWRi = Wi / Wio \qquad i = 1,\ldots,17$$

$$IENDT = \widetilde{IINDT}$$

$$ICUSTD = \widetilde{ICUSTD}$$

$$RCL = \sum_{i=1,..,17} \left(\frac{\sum_{c=1,..4} RCNCci}{\sum_{i=1,..,17} \sum_{c=1,..4} RCNCci} \right) * (PDi * \overline{W1} + JPIMi\ \overline{W2})$$

$$UNCL = \sum_{i=1,..17} \left(\frac{\sum_{c=1,..4} UNCNCci}{\sum_{i} \sum_{c} UNCNCci} \right) * (PDi * \overline{W1} + IPIMi * \overline{W2})$$

$$UNWCL = \sum_{i=1,\ldots,17} \left(\frac{\sum_{c} UNWCNCci}{\sum_{i} \sum_{c} UNWCNCci} \right) * (PDi\overline{W1} + IPIMi\ \overline{W2})$$

$$PXD = \widetilde{PXD}$$

$$PMD = \widetilde{PMD}$$

$$EXPR = \sum_{i} PXD_i * E_i/ET \qquad (\text{when } \sum E_i = ET)$$

$$IMPR = \sum_{i} PMD * M_i(-1)/MT(-1) \qquad (\text{when } \sum M_i = MT)$$

$$PEE = PXD$$

$$PMM = PMD$$

$$GDPDEF = \sum_{i-1}^{17} (PD_i * F_i)/\sum F_i$$

IMPORTS / EXPORTS

$$M_i = CP_i + CG_i + IS_i + WK_i + E_i + RI_i - XN_i + \sum_{j=1,..,17} A_{ij} XN_j \qquad \text{for all } i,s\ (i = 1,...,17)$$

if M_i LTO $M_j = 0$

$$INTMC_i = \sum_{j=1,...,17} INTMC_{ij} * XN_i \qquad i = 1,...,17$$

$$MCC_i = \sum_{j=1,...,17} MCCC_i * XN_i \qquad i = 1,...,17$$

$$MD_i = MCC_i + INTMC_i \qquad i = 1,...,17$$

$$MC_i = MD_i - INTMC_i \qquad i = 1,...,17$$

$$MSC_i = M_i - INTMC_i \qquad i = 1,...,17$$

$$D_i = XN_i - E_i + M_i$$

E_i = E + M (when M less than zero) $\qquad i = 1,...,17$

EN_i = EN_i + M_i (when M_j less than zero) $\qquad i = 1,...,17$

$\overline{E_i}$ MIN TAR EXP of E

$\overline{EN_i}$ MIN TAR EXP of EN

MST $\sum_i M_i$

MT C + TI + FT GDPFC

ELNFS $= \sum_{i=1} E_i$

MLNFS $= \sum_{i=1} M_i$

$$DDA = \sum_{i=1}^{2} XN_i + \sum_{i=1}^{2} M_i - \sum_{i=1}^{2} E_i$$

$$DDMN = XN_i + M_i - E_i \; ; \quad i = 3$$

$$DDMG = \sum_{i=4}^{11} XN_i + \sum_{i=4}^{11} M_i - \sum_{i=4}^{11} E_i$$

$$DDSS = \sum_{i=12}^{17} XN_i + \sum_{i=12}^{17} M_i - \sum_{i=12}^{17} E_i$$

$$IMSA = \frac{\sum_{1=1}^{2} M_i \; (-1)}{DDA(-1)} * DDA - \sum_{i=1}^{2} M_i$$

$$IMSMN = \frac{M_i}{DDMN(-1)} * DDMN - M_i \quad (i = 3)$$

$$IMSMG = \frac{\sum_{3}^{11} M_i}{DDMG(-1)} * DDMG - \sum_{3}^{11} M_i$$

$$IMSS = \frac{\sum_{12}^{17} M \; (-1)}{DDSS(-1)} * DDSS - \sum_{12}^{17} M_i$$

$$TIMS = IMSA + IMSNN + INSMG + IMSS$$

$$HIMSMG = \frac{\sum_{4}^{7} M_i \; (-1)}{HDDMG(-1)} * HDDMG - \sum_{4}^{7} M_i$$

CAPITAL ACCOUNTS BLOCK

CURBAL = NETDFI + NETPUB + NETOLT + NETCAP + SHTERM + NETIMF + CAPNEI + CHGRES

NETGAP = Exogenous

EEXCH = $EEXCH(-1) * \left(1 + c_m * \frac{HIMSMG(-1)}{MT\ (-1)}\right)$

IEECH = EEXCH/ EEXCH(B)

RSB = (CURBAL + NETFSY + NETTRN) * EEXCH (B)

IRC = $\overline{IRC}$

IPC = $\overline{IPC}$

TTADJ = (EXPR/IMPR) - 1.0) * ET

XTTADJ = ET * TTADJ

NATIONAL INCOME AGGREGATES

RG = MT - ET

RA = C + TI

GDS = GDPFC - C

NSS = TI - CURBAL * EEXCH/IMPR

FSS = CURBAL * EEXCH/IMPR

FSY = $\overline{FSY}$

NNFS = $\widetilde{NNFS}$

DSIT/X = (AMTOLT + INTOLT + AMTPUB + INTPUB + NETDII) * EEXCH)/(ET * PEE * 2.065)

NATIONAL ACCOUNTS - AT 1975 PRICES - BLOCK

DTT = DT * 1.582

INDTT = INDT * 1.582

CUSTDD = CUSTD * 1.582

OTX = ADTX * 1.582

GRR = GR * 1.582

GSS = GRR - CGTC

NSPR = FSSS - CGNP

ETPR = ET/CGNP

GNS = GDS + FSY

GNP = GDPFC + FSY

GNY = GDY + FSY

NINCFC = GDPVC - INDT - RIDT

CPTC = C - CGTC

CGTC = CGT * 1.784

$$GDSCOR = GDS * \frac{CS}{DS}$$

NS = TI - CUBAL * EE.485 XCH_o ÷ (IMPR/2.071)

FSSS = Y(209) * $EEXCH_o$ ÷ (IMPR/2.071)

STRAR = NETTRN/(IMPR/2.070) * EEXCH(75)

SNETF = NETFSY/(IMPR/2.070) * EEXCH (75)

$$STADJ = \frac{EXPR}{1.565} / \frac{IMPR}{2.070} - 1 * ET$$

$$GDSHSD = GDS * \frac{HS}{DS}$$

GDSADS = GDS - GDSGOV - GDSCOR - GDSHSD

GDS = CDPFC - C

C = GDPFC - ET - TI + MST

National Accts. contd:

$$TI = TI * 1.644$$

$$RG = MST - ET$$

$$XTTADS = ET * TTADJ$$

$$ET = 1.565 * ET$$

$$CCGDP = GDPFC - TTADJ$$

$$TTADJ = ET * 1.565 + \left\{ \left(\frac{EXPR}{1.565} \right) / \left(\frac{IMPR}{2070} \right) - 1 \right\}$$

$$CGNP = GDPFC + CNSFSY + CNETRN$$

$$CNSFSY = (NETFSY * .485)/(IMPR/2.07)$$

$$CNETRN = (NETTRN * .485)/(IMPR/2.07)$$

NATIONAL ACCOUNTS-CURRENT DOLLARS

$$DEXPRT = ET.PEE * 2.062$$

$$DMPRT = DEXPRT + RSB * 2.062$$

RATIO BLOCK

PSS = ASPS/GDPFC

PADTX = ADTX/GDPFC

CDPDEF = $\sum_i PD_i * YN_i/GDPFC$

SAVGAP = TS - DS

FPP = $\widetilde{FPP}$

RUNPER = RU/FP * 100

UUNPER = UU/(WP-FP * 100)

EMMM (Emp., Mining and Manuf.) = $\sum_{i=3}^{11} EN_i + \sum_{i=3}^{11} ENW_i$

MSTPR = MST/CGNP

GDSPR = GDS/CGNP

TIPR = TI/CGNP

RGPR = RG/CGNP

STRAPR = STRAR/CGNP

SNETPR = SNETF/CGNP

STADPR = STADJ/CGNP

GDSGPR = GDSGOV/CGNP

GDSCPR = GDSCOR/CGNP

GDSHPR = GDSHSD/CGNP

GDSAPR = GDSADS/CGNP

BASIC IDENTITIES IN THE MODEL

INCOME FLOW:

$$GDP(mp) = HC + HS + DT\ (L.SUB) + INDT + CUSTDUT + COR.\ TAX + COR.\ SAVING\ (INC\ DEPR) + NONTAXREV \quad \ldots\ldots\ldots\ (1)$$

EXPN FLOW:

$$GROSS\ OUTPUT_i = \sum_{j=1}^{n} a_{ij}x_j + HC_i + GC_i + I_i + E_i - M_i$$

$$\text{or} \sum_i GROSS\ OUTPUT_i = \sum_i \sum_j a_{ij}x_j + \sum_i HC_i + \sum_i GC_i + \sum_i I_i + \sum_i E_i - \sum_i M_i$$

$$\text{or}\quad GDPmp = HC + GC + I + E - M \quad \ldots\ldots \quad (2)$$

From Equation (1) & (2)

$$HS + GOVT\ REV\ (DT + INDT + CUSTOMD + CORTAX + NONTAX) + CS = GC + I + E - M$$

$$\text{or}\quad HS + GS + CS = I + E - M$$

$$\text{or}\quad HS + GS + CS + FS = I$$

$$\text{or}\quad M - E = I - S\ (i.e.,\ HS + GS + CS) \quad \ldots\ldots\ldots\ (3)$$

PRICE, REAL WAGE AND PRODUCTIVITY CHANGES

A functional relationship between price, wage and productivity has been expressed by the help of the following equation:

$$P_t = (1-A) * \left[L_o W * WI * \left\{ (EMP_t/O_t) / (EMP_o/O_o) \right\} + cr * rI * \left\{ (Capt_t/O_t) / (CAP_o/O_o) \right\} \right]$$

when P_t = Sectoral price vector

A = coefficient matrix

L_o W_o = Labor percent of gross output and wage rate at the base year

WI = Wage rate index

$EMPT_t/O_t$ - Employment component of output in period t

$CAPT_t/O_t$ - Capital use component of output

c = Capital stock per unit of output

r = Rate of return on capital index

rI = Real rate of return of capital index

If t = 1 and Base = 0 $1/(\Delta Py/_{py}) = (EMPt/O_t) / (EMP_o/O_o)$

when Py = productivity and $(\Delta Py/Py) * 100$ is p.c. productivity changes.

On the basis of the above formulation it is obvious that:

i) If the index of wage changes is exactly the same as the index of productivity changes, then the change in price will be zero, provided that the non-wage income is unaffected. This is possible if the increase in capital stock (through labor capital substitution) is completely balanced by a decrease in the rate of return of capital, or if the capital stock and the rate of return of capital remain unchanged and labor productivity is derived totally from technological improvements.

ii) Alternatively, if real wage increases pari passu with changes in productivity, but the rate of return of capital is unchanged and labor is partly replaced by capital, then the price level of all sectors will increase.